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THE
SENSORIUM:
A
Philoſophical Diſcourſe
OF THE
SENSES:
WHEREIN

Their ANATOMY, and their ſeveral SENSATIONS, FUNCTIONS, and OFFICES, are Succinctly and Accurately Deſcrib'd.

By MAT. BEARE, *M. D.*

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Αἰσθησιν, πλάσσειεν φύσις πορεν, ἠδέ τε μνήμην
Ανθρωποις, φύσεως ἀμφοβλέπειν τὸ γέρας, &c.

Quæ vero Natura Sagax miracula finxit
Artifici evolvunt hæc Monumenta Libro.
Jo. Serrani.

E X O N: 20

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MVSEVM
BRITAN
NICVM

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To the Moſt Worthy, and Truly Honour'd,

S^R. *William Courtenay*, Baronet,

AND

***Robert Rolle*, Eſq;.**

The preſent KNIGHTS of the SHIRE,

And Moſt Deſerving

REPRESENTATIVES in PARLIAMENT,

For the COUNTY of *DEVON:*

WHO Deſcended from very Antient and Noble FAMILIES; Inherit (together with their Plentiful ESTATES) All the Heroic VERTUES of Their Loyal PROGENITORS: And,

WHO Are Moſt Sincere and Worthy MEMBERS of the CATHOLICK-CHURCH of *ENGLAND*, (As in Her Primitive Eſtabliſhment) Not Blended or Corrupted with any **Schiſmatical, or Fanatic Innovations**: And alſo,

MOST Strenuous ASSERTERS and DEFENDERS of the *ANTIENT CONSTITUTION*, and *CIVIL RIGHTS* of their COUNTRY, *&c.*

TO WHOM,

With the Greateſt Deference and Submiſſion, this Author Humbly Preſumes to Dedicate this

SHORT ESSAY.

And he hopes You'll pardon the Preſumption of a Young Author in affixing Your Worthy Names to ſuch a Trifle: It is his Firſt Undertaking of this Kind, and Your Generous Acceptation of it may Encourage him to ſome greater Attempts; and Emboldned (by Your great Characters) preſumes Your Cenſure will not be ſo ſevere, as utterly to blaſt him in the Bud, that when come to more Maturity, ſome future Fruits of his Pen may with more Confidence be Addreſs'd by,

YOUR

Devoted Humble Servant,

MAT. BEARE.

Amico ſuo M. B. *In Librum ſuum Ingenioſiſſimum.*

OMNIPARENS Vis illa DEI Natura creatrix,
Quanquam operum mirâ nos majeſtate Suorum
Attonitos paſſim tenet, ac ſuſpendit hiantes,
Non tamen illa oculis, quanta eſt, occurrere noſtris
Dignatur, neq; de facie manifeſta videri
Sed Caput anguſtum ſumma ultra nubila condens,
A tergo ex longis vix cernitur intervallis.
Hinc rerum tacitas Conantem evolvere Cauſas
Oppoſitæ prohibent nebulæ; ratioq; laborat
Deficiens, ancepſq; ſui ſubſiſtit, & hæret,
Solis ut ad clarum caligans noctua lumen.

AST tibi conceſſum eſt Animæ reſerare feneſtras,
Senſuum & occultos tandem explorare receſſus
En! Admirandam magni Mundi Inſtar habendam
Corporis Humani Fabricam! quibus undique picta,
Quotve reſecta modis tenuem clareſcit ad unquem,

Illa hodie, veterum nulli tam cognita Avorum.
Magnum opus hoc; ſed enim Longi, Ingratiq; laboris,
Tentatum a Multis, Perfectum a Nemine, tandem
Auſus Es, audenti, Muſæ, & Medicator Apollo
Porrexere Manum & faverunt pollice utroque.

MACTE animo, macte ingenio, felixque laborum,
Quos Colit & præſens ætas, & Laude perenni
Rite Coronatos Cælo ventura Sacrabit.

T. C.

To the READER.

SINCE a pompous *Epiſtle Dedicatory*, and a ſubmiſſive inſinuating *Præface*, are ſo Cuſtomary, that a BOOK without it looks naked and unguarded; in compliance with the Faſhion, the *Author* of this *Treatiſe* would ſay ſomething; not in Vindication of his *Book*, let that ſhift for itſelf, but (in the uſual *Apology* made by other *Writers*) he would have you believe, that he wrote it in vacant Hours; and that as it pleas'd him in the Compoſing, he hopes it may ſome others in the Reading. For ſince *Senſuality* and *Epicuriſm* are ſo much in faſſion, one would think our *Modiſh Galants*, who are ſo very nice and poliſh'd in their external Dreſs and Habits, ſhould as well be pleas'd in reading and knowing ſomething of the exquiſite Frame and Contexture of the *Senſes* they ſo delight in; and not like *Beaſts*, purſue their *brutiſh Appetites*, without any regard to *Reaſon* or *Knowledge*.

AS for the *Garniture* and *Language* in the following ESSAY, perhaps it will not pleaſe the *Beau-Spirits*; but they muſt know, the *Author* has been moſt of his time Abroad, and is as yet a Stranger to his Native Country, and unacquainted with the pompous Strains of the *Britiſh* Tongue: He aim'd at nothing but to expreſs himſelf *Inteligibly*; and he hopes the Ingenuous Reader will underſtand his Meaning, and excuſe his *Faults*. He only deſires him to take this ſhort *Advertiſement*, That he doth not aſſume nor arrogate to himſelf the whole Subject-Matter of this ESSAY, as if he were the firſt bold Undertaker, that had ventur'd on this Nice Piece of *Phyſiology*, being very ſenſible, that many *Learned Diſcourſes* have been written thereon in *Latin*; but preſumes, that this his preſent Attempt in *Engliſh*, and the Method of it, is *New*; as are likewiſe a great many *Obſervations* and *Theorems* interſpers'd in their ſeveral Treatiſes; together with ſome *Animadverſions* on former *Diſcourſes* on this Subject, *&c.* All which he humbly ſubmits to the *Judgment* of the learn'd unprejudic'd *Reader*.

THE
Introduction,

For the better Underſtanding the *Philoſophy* of the *Senſes.*

CHAP. I.

Of the Senſes in General.

SO Admirable is the Fabrick of our *Senſes*, ſo Wonderful the Ways by which we perceive Things by 'em, that it alone might ſuffice to recal the *Atheiſt*, the moſt Inveterate (if any ſuch there be) from his Madneſs; and convince him, that no jarring fortuitous Concourſe of *Atoms* could form a Thing, ſo exquiſitely compleat in all its Faculties, as an *Animal*, without the All-ruling Guide of an Omnipotent Hand: For which *Organ* ſoever of *Animal Senſation* we conſider, we find all its Structure ſo congruouſly diſpoſed, ſo compleatly furniſhed,

as

as it muſt be the Power of God alone, the Work of an Infinite Wiſdom. If we conſider the *Eyes* ſo advantagiouſly ſituated, as deſign'd by Nature, for a *Pharos*, the Light-Houſe of our Body, to direct and guide us in our Way, and to give us a diſtant View, that by them we might ſeaſonably ſee Dangers and avoid them; and be alſo entertain'd with a full and large Proſpect of all pleaſing and delightſome Objects, the chief Comforts of Human Life. *Os Homini ſublime dedit, cælumq; tueri*, &c. They are ſo exquiſitely contriv'd, and ſo compleatly furniſh'd with all things neceſſary for their Nutrition and Preſervation, as we want Words to expreſs it; we can only ſay, *They are wonderfully made!* So accurately diſpos'd to render our Sight perfect, and to remove all Impediments which might obſtruct its Viſion, or any ways hinder its clear Diſcernments; ſo as in our *Eyes* we place an Infallibility, and what we ſee will admit of no Contradiction. If we turn to the *Ear*, it does not appear leſs wonderful in its Structure and Uſes for which it was deſign'd. Then as for *Smelling*, *Taſting*, and *Feeling*, they have their ſubſervient Parts, which upon Conſideration would ſtand us in no leſs Admiration than the former. All which *Senſes*, together with their reſpective Organs, do vary in *Animals* of a different *Species*; and often likewiſe in Individuals of the ſame *Claſs* or *Species*. For daily Obſervations make known, that ſome *Animals* have their *Hearing*; others their *Sight*; ſome again their *Smelling*; more perfect than others:

Dogs have their Faculties of *Smelling*, moſt nice, and are able to diſtinguiſh things by it; which others are only (if at all) prompted to, by the help of their other *Senſes*. *Cats* have a *Sight* and *Hearing*, moſt exquiſite; other *Animals* have none, or but a weak Sight; and theſe are help'd out with a more fine Touch, which we may believe the moſt neceſſary of our *Senſes*; and that this it is, by which we are diſtinguiſhable from other *Inſenſible Beings*: For when 'tis ſaid, an *Animal* is a Living Body, capable of *Senſe* and *Motion*, the firſt *Idea* that is repreſented to our Minds, is, that it hath the *Organ* of *Touch*; which alone no *Animal* whatſoever is without; thô the *Sight*, *Smell*, *Hearing* or *Taſte*, in many *Animals*, is found wanting; *i. e.* many *Animals* and *Inſects* want, ſome the *Sight*, others the *Hearing*, others the *Smell*, others again have no diſtinguiſhing *Taſte*: Then likewiſe, amongſt thoſe *Animals* that have all their *Senſes* entire, ſome have one more perfect than others; for we often ſay, *This ſees better than that*; *that hears better than this*, &c.

Now ſince *Nature* has given theſe *Senſes* in greater or leſs Proportion to all, but only *Animals*, whoſe eſſential and diſtinctive Difference is therefore placed in 'em, we can't imagine but they were deſtin'd for ſome peculiar Uſe; the Benefit whereof other *Inſenſible Beings* have been depriv'd. *Senſe* therefore ſeems to have been beſtow'd on *Animals* for the preſervation of their *Bodies*; that by them being guided, they might embrace what was good, and fly what they judged to be noxious: The *Eyes* help in the ſearch of their Food; the *Smell* farther directs them in their Choice, which by the Taſte is determined, ſo that by their *Sight*, *Smell*, and *Taſte*, they learn what Food to choſe, and what is hurtful to them to avoid. Their *Sight* likewiſe and *Hearing*, forewarns them the Dangers they're to ſhun: The *Touch* is almoſt Univerſal, ſince by it all the others are perform'd. In fine, all the different manners of *Senſation* conduce more or leſs to the preſervation of our *Bodies*, as will be more at large prov'd, when we come to treat of the *Senſes* in particular. We'll now advance to the Definition of *Senſation* in general;

Which is nothing elſe but the Manner whereby we know and perceive external *Objects*, in what they're ſenſible and corporeal, *i. e.* in ſo much as they have Extenſion, Figure, Motion, and all thoſe Qualities which are neceſſary for the rendring *Objects* ſenſible; all which Qualities (whatſoever ſome Men may imagine) are no ways really diſtinct from *Matter*, or its *Modifications*: For what do we underſtand by ſenſible Qualities, but the Mechanical Diſpoſition of *Matter*, which we place under Figure, Situation, Magnitude, Reſt, Motion, *&c.* by virtue of which *Modifications*, *Bodies* make Impreſſion on our *Organs*? For how could we ſee an *Object*, unleſs its Particles were diſpos'd to reflect the *Rays* of *Light*? From whence proceeds the difference of *Colours*, but from the different *Figure* and *Poſition* of the *Particles* in the *Body* colour'd? How ſhould we perceive ſo many various *Taſtes* in things, unleſs they were accordingly qualify'd; that is, unleſs ſome of 'em were endued with *Particles* of one Figure and Magnitude, ſome of another? How came we to hear Sounds in different Degrees and *Altitudes*, if they were not accordingly *modify'd* and diſpos'd? in ſhort, from theſe Diſpoſitions, and different Qualities of Subjects, flow all different *Senſations*; ſo that a ſmall *Object* does not cauſe ſuch an Impreſſion on our *Organs* as a great one; a round *Object*, as a long one, *&c.*

The *Organs* of our *Senſes*, by which the Impreſſions cauſing *Senſation* are receiv'd, are not to be look'd upon as ſimple *Conduits*, by which the *Object*'s Impreſſion is only to paſs, but as having a particular Structure, by which they are rendred at the ſame time fit to receive the *Motion*, and *Impreſſion* of *Objects*; and alſo, to qualify and *modify* 'em for ſuch, or ſuch a *Perception*: Which Structure of the *Organs* will be deſcrib'd in the *Anatomies* of each particular *Senſe*.

CHAP. II.

Of the Reflux of the Spirits *to the* Brain, *and the Manner after which the* Soul *perceives the Qualifications of ſenſible Objects.*

ALTHO' the Natural Courſe of the *Animal Spirits*, is from the *Head* to the other Parts, yet this Courſe can't but be inverted, as often as any *Object* makes an Impreſſion on our *Organs*; ſo that they are forced from the *Capillary Nerves*, to flow to their Fountain the *Brain*, by the *Nervous Channels*, whoſe Extreams, if compreſſed, or any way diſtracted, cauſe this inordinary Motion in the *Spirits*.

But ſince this Natural Courſe of the *Spirits* can't be inverted, but it muſt excite in us a *Perception* of thoſe *Objects*, which were the Cauſe of this their irregular Motion, the thing that comes next into Conſideration is, the *Proportion* of thoſe external *Bodies*; which is, what *Senſe* and *Perception* are. To attain to the Knowledge of which, Three things are to be conſidered; Firſt, the Compreſſion on the *Capillary Fibres* of the *Nerves*; Secondly, the tranſporting of this Compreſſion to the *Brain*, which is the *Senſorium commune*; and Laſtly, the Perception which is excited by this Reflux of the *Spirits*: For nothing is more certain, than that *Objects*, when they ſtrike on our *Organs*, communicate a Motion to the *Nerves*; either of *ſimple Preſſure, Divulſion, Dilatation*, or *Vellication*; by which, the *Spirits* ſhut up in the *Nerves* are ſent back to the *Brain*; for ſince the *Nerves* are always turgid with this *Fluidum Spirituoſum*, it follows, that if they receive any *Motion* toward their Ends, the *Spirits*, determin'd to the *Organs*, muſt be driven back by their proper *Channels* to their *Fountain* the *Brain*, and that in a fluctuating and *undulatory* manner; ſo that its *Motion* being communicated to the *Capillary Fibres*, they move in like manner the *Animal Spirits* contain'd in their Extremities, which again ſtrike their neighbouring *Particles*, and ſo on 'till they reach the *Brain*.

In fine, when this *Fluctuation* of the *Spirits* is come to the *Brain*, it cauſes nothing more there than a *Local Motion* of the *Fibres*, without any *Senſation*; the *Brain* of itſelf being uncapable of *Perception*: From whence it follows, that all *Perception* is to be refer'd to the *Soul*, which being united to the *Body*, receives ſuch, or ſuch a *Perception*, as often as ſuch, or ſuch a *Motion*, is tranſlated by the *Spirits* to the *Fibres* of the *Brain*. From whence we may infer, that the *Soul*, inſomuch as ſeated in the *Brain*, perceives the Impreſſion of the external *Objects*, not as united to the *Organs* of the outward *Senſes*; that we may with the *Stoicks* compare the *Soul*, inſomuch as it perceives the *Objects* which make Impreſſion on our *Organs*, to a *Polypus*, whoſe Head is the ſame in compariſon to his many Legs, as the *Brain* to the many *Nerves*; which ariſing out of its Subſtance, are diſpers'd through-out the whole *Body*; for in like manner they place the Head of the *Soul* in the *Brain*, and its Arms are diſpers'd thro' the *Organs* of *Senſe*, or rather the *Nerves*; by which they receive the Impreſſion of *Objects*: From whence we may rightly conclude, that *Senſation* is improperly ſaid to be the Work of the external *Organs*; and that it would be more proper to ſay, that the Impreſſion of *Objects* is felt and perceiv'd in the Foot by the *Soul* in the *Brain*; that the Pain cauſed in the Foot, is convey'd by the *Nerves* to the *Brain*; which is farther prov'd, by the Pain which is felt in the little Finger, and ſometimes in all the Fingers, by ſtriking the Elbow; for the *Nerve* which ends in this Finger, being compreſs'd or diſtracted by the ſtroke on the Elbow, affects the *Brain* in the ſame manner as it would, if compreſs'd in the Finger itſelf; becauſe we always refer the Senſe of Pain to that Part, the *Nerve* thus agitated belongs. From whence, as well as from the following *Example*, is proved, that the *Soul* refers the *Senſation* to the *Organs*, as a Man that ſtrikes with the end of a Stick, a Stone, or any hard Subject, by which the Stick is reflected, is wont to refer the *Object* which reflects it, and the Cauſe of the Impreſſion he feels; not to his Hand, but to the end of the Stick: In like manner the *Soul*, when the Extremity of the *Fibres* are mov'd, and their Motion, by the *Undulation* of the *Spirits*, transferred to the *Brain*, is wont to refer the *Senſation* not to the *Brain*, but to the Extremities of the *Nerves* where the Impreſſion begun. So likewiſe *Colours*, which are perceiv'd by the *Eye*, are refer'd to the *Objects*.

Objects are perceiv'd by our *Senſes* to move, inſomuch as different parts of the *Object* ſtriking on the ſame, or different Extremities of *Nerves*, ſucceſſively cauſe different *Refluxes* of the *Spirits* to the *Commune Senſorium*, one after another.

All *Perception* is cauſed in the *Soul*, by the Motion which is excited in the *Nerves* and *Organs*; as likewiſe the *Reflux* of *Spirits* to the *Brain*: For how could the *Air* excite in us the *Senſation* of Sound, unleſs by Impelling the *Drumskin* with its trembling and *verberating Motion*, it were by the *Auditory Nerves* which it falls on, carry'd to the *Brain*? How ſhould *Objects* have a Power of exciting in us the Senſe of *Colour*, unleſs they reflected the *Light*, which paſſing the Humours of the *Eye*, cauſes a Motion in the *Fibres*, which conſtitute the *Retina*? In like manner, neither *Pain* nor *Titillation*, *Smell* nor *Taſte*, with their diſtinctive *Species*, could be explicated, without having Recourſe to the Motion rais'd in the *Nerves*.

The diverſity of *Motion*, is partly to be drawn from the Variety of *Objects*, partly from the different *Formation* of the *Organs*; for the *Fibres* compoſing the *Retina* (which is the chief *Organ* of *Viſion*) are far more *ſubtile* than thoſe which make up the *Organ* of *Taſte*: So likewiſe the little

tle *Globuli Ætherei*, which move the *Fibres* of the *Retina*, don't in any manner affect thoſe of the other *Senſes*. Now the Variety of the *Senſes* does not ſo much depend on the different Condition of the *Nerves*, as the various *Texture* of the *Parts* into which they are Inſerted: For as a *Cord*, to which *Bodies* of a different kind are hung, trembles after one manner with one *Body*, and after another, with another; after one manner with a Spunge, and after another with a Leaden-Ball: So likewiſe the *Nerves*, according to the Parts which are faſtned to 'em, have ſometimes one, ſome times another Motion. *In fine*, the different ways by which things are perceiv'd, are partly to be drawn from the *Contexture* of the *Organs*, from whence we *taſt* with our *Tongue*, *ſmell* by our *Noſe*, *hear* through our *Ears*, *ſee* with our *Eyes*, *feel* by our *Skin*, ; partly from the diverſe Motion, Nature and Figure, of the *Bodies*, which make Impreſſion on our *Senſes*; for a *Body* that is in a quick Motion, ſtirs up in us a *Senſation* different from a *Body* whoſe Motion is but weak. A round *Body* does not make ſuch an Impreſſion as a long one, *&c.* But we muſt look on the *Nerves* and *Spirits* as wholly Indifferent for all ſorts of Motion, and only to be determin'd by the Diſpoſition of the *Organs*, and Impreſſion of *Objects*.

From what has been above-ſaid, you may gather, that all the *Senſes* may be reduc'd to the *Touch* alone; ſince 'tis by this, that all the others receive the Impreſſion of *Objects*, ſtriking on the external *Organs*: But becauſe the Diverſity of the *Senſes* ariſes from the Diverſity of the *Organs*, ſubſervient to them, we therefore ſhall diſtinguiſh *Five Senſes*, conſidering the *Five Organs*, by each of which we perceive different Qualities of *Objects*; *viz.* The *Skin*, the *Membranes* of the *Eye*, the *Internal Membrane* of the *Noſe*, the *Internal Ear*, and the *Tongue*; from whence we conclude, that there are *Five* diſtinct *Senſes*, *viz.* The *Sight*, *Hearing*, *Smell*, *Taſte*, *Touch*: To theſe ſome likewiſe add *Two* more, *i. e. Hunger*, which lies in the *Stomach*; and *Thirſt*, whoſe *Organ* is the *Fauces Imæ*; which are therefore by ſome rank'd among the *Senſes*; becauſe they affect, after a different manner from the others, and conſequently produce a different *Senſation* in the Mind. The *Venereal Senſe* may be likewiſe joyn'd with the reſt, as being Inſtructed with its proper *Organs*, differing as much from the Senſe of *Feeling*, as we find other *Organs* differ among themſelves. We place therefore the Diſtinction of the *Organs*, and conſequently the different *Species* of the *Senſes*, in this, that one raiſes ſuch a *Perception* in the *Soul*, of which another is altogether incapable; ſo that one would not be much out, if he did divide the *Objects* of our *Senſes* into Proper, and Common; into Proper, which can only make Impreſſion on one *Organ*; as the *taſt* of things is only tranſlated to the *Brain* by the *Tongue*, the *ſmell* by the *Noſe*, and *ſonorous Objects* ſtrike on the *Ear*, *&c.* And Common, which can move not only one, but more *Organs*:

Of this kind are Bodies in Motion, or Reſt, Great or Little, *&c.* which make Impreſſion not only on one *Organ*, but a great many at once; ſo the *Eye* does not only perceive *Colours*, but *Cold* and *Heat*, the Roughneſs and Smoothneſs, Reſt and Motion of Things; the ſame of the other *Senſes.*

The *Senſes*, by ſome, are divided into Inward and Outward; but this Diviſion, ſince all *Perception* is form'd in the inmoſt Receſſes of the *Brain*, is altogether inſignificant; for all the *Senſes* are Internal; and therefore they would have done more wiſely, had they divided them into *Common Senſe* and *Memory*; for by obſerving, that there are Two kinds or ways of perceiving *Objects*, viz. either when the *Nerves* receiving an Impreſſion from without, a Motion by the *Undulation* of the *Spirits* is carry'd to the *Brain*, by which a *Senſation* is excited in the *Soul*; or elſe, when the *Spirits* recollecting themſelves, repeat their former Courſes in the *Brain*; by which the Parts before affected after this or that manner, (retaining a Diſpoſition to the ſame Motion) are again moved as before, by the firſt Impreſſion of the *Spirits*: They might with good Reaſon have given that the Name of *Senſus Communis*, and this of *Memoria*, or *Memory*; and they are in this diſtinguiſhed, that *Common-Senſe* is the *Perception* of an *Object* actually Impelling the *Organs*; but *Memory* is cauſed by a ſecondary *Reflux* of the *Spirits* into the ſame *Fibres*, after the former manner, by which the *Perception* of the ſame *Body* is renew'd afreſh.

But to put an end to this Chapter: We give the *Memory*, and *Senſus Communis*, the ſame Seat in the *Brain*; for as *Common Senſe* is caus'd by one *Influx* of the *Spirits* into the *Fibres* of the *Brain*, ſo the *Memory* is form'd in the ſame *Fibres*, which are always prepar'd for receiving ſuch a particular *Reflux*, i. e. thoſe *Fibres* are diſpos'd upon a Recollection or ſecond Thought of the abſent *Object*, to be diſtended with the *Spirits* as before: For the *Fibres* are more eaſily diſtended at the *Reflux*, than *Influx* of the *Spirits*; the latter being a Preparative for the former; ſo that by Uſe they are rendred more *Relax*, and fitter for the ſame Motion. *In fine*, the *Common Senſe* of *Touch* is perceiv'd, when the Impreſſions are transfer'd from the *Organs* of *Touch* to the *Brain*; that of *Sight*, when the Impreſſion is from the *Eye*, &c. But the *Memory* is a thinking on the ſame *Objects* when abſent, cauſed by an again Diſtention of the ſame *Fibres*, which were moved in the firſt Impreſſion: For which Reaſon, thoſe that are *melancholy Mad*, are thinking almoſt continually of the Cauſe of their *Madneſs*; becauſe thoſe *Fibres* being relax by frequent *Influxes*, lie more open to the *Spirits*.

CHAP. III.

Of the Nature and Secretion *of* Animal Spirits.

SINCE we conſider the *Animal Spirits*, not only as the Author of all the Motion of our *Bodies*, but alſo the Cauſe of all our *Perceptions* and *Senſations*, we ſhall not go far from our preſent Undertaking, if we make a Halt in the way, and ſtand to take a View of their Riſe and Nature: And firſt, that the *Nerves* are always *replete* and *turgid* with *Spirits*, is proved from a *Ligature*, *Compreſſion*, or *Præſciſion* of a *Nerve*, which is no ſooner perform'd, but all the Parts wherein it preſided immediately looſe their Motion and Senſe; and this for no other reaſon, but becauſe the *Spirits* are impeded from flowing into their Parts.

Now ſince the *Spirits* are the Preſervers and Cauſe of the *Motion* and *Senſe* of our *Bodies*, they muſt be made up of *Particles* accordingly, moſt ſubtle and penetrating; of which penetrating and ſubtle Nature, there's nothing can be found, which more participates, than the *Nitroäerium*; and therefore we maintain, that the *Spirits* are of the Nature of this *Nitroäerium*: And the more willingly, becauſe this is the one Opinion by which all *Phænomena's* may be explicated, which can be objected againſt the Nature of *Spirits* otherwiſe

therwiſe underſtood. For in the firſt place, neither the Structure of the *Brain*, nor yet the *Secretion* of *Animal Spirits*, does any way deſtroy this *Hypotheſis*; and then nothing is more capable of a quick and vehement Motion, than *Nitre* mix'd with *ſulphurous Particles*. Thirdly, *Ptyſical People*, whoſe *Lungs* are out of order, are always under a want of *Spirits*, and always unfit for long *Motion*; becauſe ſince the *Spirits* are made out of N*itre*, and this N*itre* firſt communicated to the *Blood* by the *Lungs*, it follows, that if the *Lungs* are any ways indiſpos'd, as in *Ptyſical Perſons* they are obſtructed, in whom likewiſe *Reſpiration* is weakned, the N*itre* is not in ſo great a quantity communicated to the *Blood*, and conſequently the *Spirits* are not depoſited in their uſual quantity; ſo that *Motion* likewiſe, ſince 'tis wholly dependent on the *Spirits*, muſt be Impaired. Fourthly, we may draw an Argument from Experience; for in Diſſecting of *Dogs* 'tis obſerv'd, that thoſe Parts which after Death are expos'd to the *Air*, have a ſort of *trembling* and *convulſive Motion*; from whence we may gather, that the external *Air*, by its *nitrous Particles*, mingling with the remainder of the *Sulphur* of the *Blood*, ſupplies the *Influx* of the *Spirits*.

Our Opinion therefore is, that the *Animal Spirits* are made out of the N*itre*, a Portion of *volatile alchaline Salt*, and ſomething of a *watry Humour*; which *Three Bodies*, ſince they are not only found in the *Lymph*, but the *globulous* part of the *Blood*, we therefore ſay, that not only the *Lymph*, but alſo the *Blood*, or both, ſupply the *Matter*, out of which the *Spirits* are form'd: But after what manner this is done, we will hereafter explain.

What the Ingenious Dr. *Willis* ſays of the *Spirits* being *lucid*, and diffus'd thrô the *Body*, after the manner of the *Rays* of *Light*, is altogether *Fictitious*; and ſo likewiſe is the *Flamma Vitalis*, which he feign'd in the *Heart*: For what Grounds or Reaſon can be brought for this *Brightneſs*? Truly none. Could it be the quickneſs of their *Motion*; or rather the *Modification* and *Figure* of the *lucid Body*; or elſe could he draw it from the *Splendour* and *Pellucidity* of the *Eye*? But this *Splendour* comes from the Diſpoſition of the *Pores* of the *Cornea*, and *Humours* fit for tranſmitting the *Rays* of *Light*; neither does the *Splendour* of the *Spirits* any ways conduce to the *lucidity* and *ſparkling* obſervable in the Eyes of *Cats*, and other *Animals*: But this is to be drawn wholly from the internal Motion of the *volatile* and *fermentative Principles*, composing the *watry Humour*, which ſo exagitates the *Particles* of the ſecond *Element*, as to cauſe this *Fulgency*.

We now proceed to the *Generation* of the *Spirits*; which according to ſome, is done out of the *vital* Spirits, or the moſt thin Portion of the *Blood*; and likewiſe the *Air* drawn in by the *Noſe*, and the *Os Cribroſum*; which is a meer *Chymera*, ſince there is no Paſſage from the *Noſtrils* to the *Brain*; neither do the Antients ſhew how *vital Spirits* are transform'd into *Animal*, but by recurring to the proper Faculty of the *Brain* and its *Ventricles*; nor do they any ways explicate how the *Spirits*, from the *Ventricles* of the *Brain*, get into the nervous *Channels*. *Spirits* therefore, according to the Opinion of the *Neotericks*, are made out of the *Blood*, and in the *Blood*; for any one that will but conſider the *Motion* which the *Blood* undergoes, before it comes to the *Glands* of the *Brain*, circulatory and fermentative, thro' all the ſmall capillary *Veſſels*; and the various *Attritions* of its *Principles*, which it can't but receive in ſo long a Journey, will eaſily conceive how the moſt ſubtile and thin *Particles* are ſecreted, how the moſt volatile and extricate *Parts* of the *Blood* get into the *Glands*, by Nature ſeated in the cortical *Part* of the *Brain*. The Animal Spirits therefore are no otherwiſe generated in the *Blood*, than the ſpirituous Part of *Wine*; for whereas new *Wine* (a *Body* thick and tenacious) tho' urg'd by the greateſt Heat, will afford no Spirits at all; but after ſome time's ſtanding and fermenting, will ſupply no ſmall quantity of them: Ev'n ſo our *Blood* by its continual *Motions*, ſuffers ſuch Diviſions of its Parts, that the *Nitro-aerial* Particles before intangled by the globulous Part of the *Blood*. now get loſe, and herding with the other volatile *Salts*, are united; as the Spirit of *Nitre* with *Sal Armoniack*, in the Compoſition of our *Aqua Regia*.

The Animal Spirits being thus perfected in the *Blood*, we may now turn to them in the Ventricles of the Brain, and ſee which way they are here ſeparated into the *Glands*. For this end let us ſuppoſe, with others, that the *Brain*, as its Circumference, is glandulous, that its *Glands* have the reſemblance of your *Grape-ſtones*, and are each inſtructed with an excretory *Veſſel*, or medullary *Fibre*; and therefore that the Spirits are no otherwiſe depoſited in the *Glands* of the *Brain*, then the other Recrements are in their reſpective *Glands*; and conſequently by a *Gland*, we mean no other than a *Strain*, or *Filtre*, by which diverſe *Liquors* are ſeparated from the Maſs of Blood, into ſome proper containing *Veſſel*. Thus are all our Recrements ſecern'd from the *Blood*, and thus do theſe *Glands* vary according to the Variation of the Liquors they are to receive: The lymphatick *Glands*, which have their Seat in many parts of the Body, are of a Magnitude and Figure appropriate for the Reception for a recrementitiory *Lymphe*, which, if expoſed to the Sun is coagulated, if mixed with the *Acids* loſes its Fluidity (from whence 'tis inferr'd that the ſulphurous Part abounds in it) if with a *Chalines* 'tis again diſſolv'd; Secondly, the *Liver* is indew'd with certain *Glands*, by which is ſecern'd from the *Blood* a yellow *Liquor*, call'd the *Bile*, it obtains a fix'd ſulphurous Spirit. The *Vrine* likewiſe (which is a yellowiſh *Lymphid Lotium*, abounding with a *Corroſive Alkaline)*

line) has *Glands* of a particular Magnitude; whereby it is ſeparated from the purer *Blood*; ſo of all the other Recrements which are too numerous to be here inſerted: Not to go farther from my purpoſe, the *Animal Spirits* are alſo ſecerned from the *Blood* by *Glands* abovemention'd, ſeated in the cortical Part of the *Brain*; whether the Blood being driven by the ſucceſſive Motions of the *Heart* and *Arteries*; there are always ſome of its fineſt Parts admitted to theſe *Glands* of a Magnitude only proper for the Reception of the moſt ſublim'd *Spirit* of the *Blood*; the Remainder unfit to paſs by this *Filtre*, driven on by the capillary *Arteries*, to the Veins, and by theſe again to to the Heart.

Laſtly, the Spirits from theſe Glands are received into certain ſpongeous *Fibres* (one of which is placed at the bottom of each *Gland*) and by them conveyed to the interiour Receſs of the Brain. Some helps there were neceſſarily required for the furthering of this great *Work* of *Secretion*, as the *Pulſes* of the *Heart* and *Arteries*; ſupplying greater *Force* to the *Spirits* in the *Glands*, and puſhing them forward in the excretory *Fibres*. Secondly, the Fall and Riſe of the *Brain* at each Contraction and Dilatation of the *Heart*, forces the *Animal Spirits* more eaſily into the *Nerves*. Thirdly, the Reciprocal Motions of the *Dura* and *Pia Mater*, by which the *Brain* is compreſs'd, do procure a more eaſy *Deſcent* for the *Spirits* from

the

the *Brain* into the moſt remote Parts of our Body, thro' the nervous *Channels*; thro' the *Olfactory Nerves* to the Noſe, by the *Optick* to the *Retina*, by the *Motorii Oculorum* to the Muſcles of the Eyes, by the *Pathetici* to the oblique Muſcles of the Eyes, by the *Maſticatorii* to the Jaws and other parts of the Mouth, by the *Auditorii* to the Ear, by the *Vocatorii* to the Lungs and Gullet, and Tongue, by the *Motorii internorum membrorum* to the inward Parts; and this is the *Parvagum* diſtributed thro' moſt of the *Viſcera* and *Muſcles* of the lower Belly, by the *Linguæ Motorii* to the *Tongue*, its *Muſcles*, and the *Æſophag*, by the *Reſpiratorii* to the little Bladders of the Lungs, *&c.*

A
TREATISE
OF THE
SIGHT.

CHAP. I.

The Anatomy *of the* Eye.

I Take my beginning from the *Anotamy* of the *Eye*, which is a part more noble and worthy our Conſideration than the other Organs are, and alſo require a more curious Hand for illuſtrating its Parts.

Firſt therefore we find that all *Animals* have two Eyes, both that their Sight may be more perfect, and likewiſe that if any Chance ſhould deprive them of one, they might ſtill be exempted from Darkneſs by the others Perfection.

Secondly, their Shape (when diveſted of their *Muſcles*, *Nerves*, &c.) is altogether Spherical, a Figure moſt proper for a quick Motion, and receiving and modifying the Rays of Light.

Thirdly, their Colour much varies, not only in different Species of *Animals*, but alſo in Individuals of Species: This diverſity of *Colours* is diſcernable in the *Iris*, round the *Pupilla*. The largeneſs likewiſe of the Eye differs, as that of the Colour does.

The Conſent which our Eyes obtain one in reſpect of the other, as that one being mov'd towards any *Object*, the other immediately is directed the ſame way; proceeds, as ſome think, from the Union of the third *Pair* (i. e. *Oculorum Motorii*) at its riſe, ſo that the Spirits can't be determin'd to one only Eye.

The Situation of the Eye is ſufficiently known to be in the forepart of our Bodies, in a Cavity on each ſide of the Noſe, called the *Orbita*, inveſted with a thin Membrane ariſing from the *Pericranium*, to which the Muſcles of the Eyes are faſtened.

To deſcend to a more particular Deſcription of the parts of the Eye, we ſhall begin at its Curtain, or the *Eye-lids*, which defend the Eye from all external Injuries; theſe are both moveable, as any one may obſerve; they are opened by right Muſcles, cloſed by *Orbiculary*, which are placed near the *Cilia*, or Eye-laſhes, a Subſtance cartalagenous, at the edges of the Eye-lids, fenced with a row of Hairs, attaining to a particular height: Above this likewiſe is the Eye-brow, or *Supercilia*, thicker beſet with Hairs, defending the Eye from Duſt, *&c.*

The Eye-lids have two Corners, one on each ſide, which we call *Canthi*, furniſh'd with a *Gland*, ſeparating a ſerous Liquor from the Blood, by which the Eye is water'd, and moiſtned; you may call them *Puncta Lacrymalia*, ſince from hence the Tears are drawn.

If you remove the *Palpebræ*, or Eye-lids, the Eye comes into view, made up of *Muſcles*, *Nervos*, *Tunicles*, *Humours*, *Arteries*, and *Veins*.

Its *Muſcles* are not different from thoſe of the other parts, but are a *Congeries* of fleſhy *Fibres*, joined one by another, deſtin'd for the local Motion of their appropriate Organ; they are in Number ſix to each Eye, *viz.* four ſtraight ones, two oblique; the ſtraight (or *Recti*) move the Eye up and down, to right and left directly; the oblique are imploy'd in the oblique or rowling Motions of the Eye, theſe receive *Nerves* from the fourth *Pair*, or *Parpatheticum*, which is ſo call'd from πάθος, *Paſſio*, becauſe this Motion expreſſes Paſſion; from whence this Motion of the Eye is called *Amatoria*.

The ſtraight *Muſcles* derive their *Origens* from the place where the *Optick Nerve* enters the *Orbis* of the Eye, and ariſe from the *Membrane*

that

that involves this *Nerve*; their middle, as of other *Muſcles*, is made up of fleſhy *Fibres*, only differing from thoſe of the *Tendon*, in that they are more lax: The End, or *Cauda*, is a thin and membranous *Tendon*, whereby they are faſtned to the *Tunica Cornea*, near the *Iris*.

The firſt of the *Muſcles* is call'd *Attollens*, or *Levator*, it moveth the Eye upwards, and is the largeſt of all the *Muſcles* belonging to the Eye; ſome call it *Superbus*, or proud, becauſe this Motion of the Eye denotes Pride and Contempt.

The ſecond is called *Deprimens* and *Humilis*, it is *Antagoniſt* to the former; and as that manifeſts Pride, this is a mark of Humility.

The third is called *Adducens* and *Bibitorius*, it moves the Eye towards the Noſe, which Action of our Eyes in Drinking is obſervable.

The fourth is called *Abducens*, having an oppoſite Motion to the former, by ſome ſtiled *Indignatorius*, as us'd by People in Anger.

As for the two oblique Muſcles, ordinarily underſtood by the Name of *Circumagentes*, one of them is called *Superiour*, the other *Inferiour*; the firſt is ſlendor and ſhort, the other the thineſt of all the Muſcles belonging to the Eye.

There are three *Pair* of Nerves beſtow'd on the Eyes, one whereof ſerves wholly for Viſion, the others for the Motion of the Eyes.

The firſt *Pair* is the *Par Opticum*, or Optick Nerves, whoſe *Fibres* are expanded all along the *Retina*, ready to receive the Impreſſions of the Rays of *Light*, and convey them by the *Undulations* of the Spirits to the Brain.

The ſecond is called *Par Oculorum Motorium*, as beſtowed wholly on the Muſcles; it ariſes from the *Baſis* of the *Medulla Oblongata*, behind the *Infundibalum*; at their riſe they are united, but ſoon again divide and ſeparate, determin'd one to each Eye; this is not ſo large as the forementioned Pair, but of a more compact Matter.

The third Pair is named *Patheticum*, and beſtowed on the oblique *Muſcles*, but moſtly on that called *Trochlearis*; it proceeds from the top of the *Medulla Oblongata* (which is the place from whence the Nerves ariſe in the Brain) behind the Glands, called *Nates* and *Teſtes*; from thence covered by the *Dura Mater*, it deſcends to the *Orbit* of the Eye.

The *Tunicles* of the Eyes are ſix, the firſt is called *Adnata*, which almoſt ſurrounds the Eye, and grows to the other Tunicles, from whence it has its *Denomination*: It is called *Conjunctiva*, as joyning the Eye to the *Orbit* and inner *Bones*, in which it ſeems to have ſomewhat of the Nature of a *Ligament*; 'tis this *Tunicle* which compoſes the White of the Eye, and is thin, light, and of an exquiſite Senſe, beſprangled with a Number of little Veſſels, which ſcarce appear, unleſs in ſome *Turgeſcency* of the Eye, as in an *Ophthalmy*, or any flux of *Humours* to the Eyes.

The *Cornea* is the ſecond *Tunicle* which, in diſſecting the Eye, doth appear in its foremoſt and convex part, *Pellucid*, and like Horn, *Tranſparent*; but behind (where *Concave*) *Fuſcous* and *Opack*, by ſome 'tis called the *Sclerotica*, becauſe it grows to the *Dura Mater*, which is the thickeſt and outermoſt *Membrane* of the Brain, ſerving for a Coat to the *Nerves*, from the Brain, and alſo to defend and protect the external part of the Eye from all Injuries, by ſurrounding it.

The *Uvea* appears, thirdly, after the removal of the *Cornea*; this *Tunicle* reſembles a black Grape, it is likewiſe named *Choroides*, or *Choris Formis*, from the ſimilitude it bears with the Membrane *Chorion*; (which is the ſecond Membrane, or middle, wherewith the Child is involv'd) it ſprings from the *Pia Mater*, or inward Membrane of the Brain, and is indued with a Faculty of *Contraction* and *Dilatation*; from whence it proceeds, that the Corner of the *Pupilla* is ſometimes larger, ſometimes leſs. This *Tunicle* makes up the *Pupilla*, round which the *Iris* is placed, ſurrounded with certain *Ciliary Fibres*, ſome longer, ſome ſhorter, extended on the *Chryſtalline Humour*, which it bends to its place.

The fourth is the *Retina*, ſo call'd becauſe it reſembles a Net; it is formed out of the thin *Filaments* of the *Optick Nerve*, and thought the principal Organ of *Viſion*.

The *Aranea* appears the fifth, whoſe *Texture* is like that of a *Spider*'s Web; this is alſo call'd *Chryſtalloides*, becauſe it contains in it the *Chryſtalline Humour*; 'tis faſten'd by the *Ciliary Ligaments*.

The ſixth and laſt is the *Vitrea*, containing the *glaſſy Humour*, keeping it in its proper Bounds, and ſeparating it from the *Chryſtalline Humour*; of a delicate and thin *Texture*, ſcarce viſible, eſpecially that part which is joyn'd with the *Chryſtalloides*.

The *Humours* of the *Eyes* come next into Conſideration, and are in Number three, *viz.* the *Watry*, *Vitreous*, and *Chryſtalline*; the laſt of which is the moſt Noble, and the *Soul* and *Center* of the *Eye*.

The *watry Humour* is altogether *Pellucid*, and reſembles clear *Water*: If any *Specks* (as when the thick *Sulphurs* and *Salts* unite) chance to ſwim in this *Humour*, it ſeems as if *Gnats* were flying before the *Eyes*; and theſe, if they gather into one, cauſe a *Film*, and are call'd a *Cataract*; this *Humour* has its Seat between the *Tunica Cornea* and *Chryſtalloides*.

Between this and the *Vitreous* is placed the *Chryſtalline* Humour, *Diaphamous* and *Tranſparent*, more *Convex* behind than before; it has the appearance of the cleareſt *Chryſtal*.

The third and laſt *Humoar* is the *Vitreous*, which takes up the remaining ſpace of the *Eye*, reſembling molten Glaſs; this is thinner than the *Chryſtalline*, but more turbid and *Opack* than the *Aqueous*, and exceeds both in quantity; in its hinder part round, before plain, in the middle concave; and in its *Concavity* is placed the *Chryſtalline Humour*.

There are *Arteries* ſent hither from the *Carotides*, which accompany the *Optick Nerve*, beſtowing ſome *Twigs* on the *Muſcles*, and other Parts. The *Veins* run to the branchings of the *Jugulars*. Thus much for the *Anotamy* of the *Eye*, in which, as ſhort as poſſible, is deſcrib'd all thoſe Parts which will be neceſſary for the right underſtanding the following Chapters.

CHAP. II.

Of Light, *the firſt* Object *of* Sight.

SINCE *Light* is the *Source* and *Foundation* of our *Sight*, and an *Object*, without which it fails, 'twill not be from our Undertaking, firſt to take a ſhort View of it, before we advance to a more particular Application of *Viſion*.

And firſt, we may either take this word *Light*, for the *Senſation* ariſing in any one, that with open Eyes views a *lucid* Body; or elſe for a Power in *lucid* Bodies of exciting in us this *Senſation:* If we take it for the *Actus*, or *Senſation* itſelf, *Experience* will beſt explain it, every one being the beſt acquainted with their proper *Affections*; neither had a Blind-born ever an *Idea* of *Light*, as *Light*, or *Formaliter*. But if you will underſtand *Light*, as the *Agens*, or *Potentia* only proper to *lucid* Objects of cauſing this *Senſation*, we may define *Light* to be a violent and continual *Impulſe* of the *Materia Subtilis* in *lucid* Bodies; for, from whence ſhall we derive the *Light* obſerv'd in Fire, but from the continual and nimble *Concuſſion* of its Particles? From whence do the Sparks ariſing from the *Attrition* of Flints; from whence thoſe ſeen in perfricating a *Cat*'s or *Horſe*'s Hair, borrow their *Light*, but from the rapid *Motion* of their

Particles? In fine, this *Light* is what, in the Schools, they ſtile *Lumen Primum*, or *Lux*, and exiſts in *lucid* Bodies, as the *Sun*, &c.

Our ſecond *Aſſertion* ſhall be, that *Light* is propagated by an *undulatory Motion* of the *ſubtile* Matter in *Diaphanous*, or *Tranſparent* Bodies, from whence 'tis ſent, as from the *Center*, to the *Circumference*.

To render this *Aſſertion* more intelligable, let us ſuppoſe a *lucid* Body, *v.g.* the *Sun*, in the middle *Space*, or *Center* from whence *Light* is propagated, and in it the *Materia Subtilis*, which is vehemently agitated, ſtriving on all ſides to break its Priſon; I ſay then, that this *Motion* of the *ſubtile* Matter in the *Pores* of the *lucid* Body, muſt neceſſarily communicate its *Motion* to the *vicine* Particles, (for we ſuppoſe the whole Space repleat with this *Æthereal Fluid*) and thoſe again to others, and ſo on 'till this *Motion* arrives at an Eye, when the *ſubtile* Matter, meeting the *Retina*, determines the *Perception*. We may therefore compare this *Agitation*, which is perform'd in *diaphanous* Bodies, with the Trembling ſeen in the Water upon throwing in a Stone; for as in the Water, the Particles put into *Motion* by the Stone, move in a right Line their neighbouring Particles, *&c.* which *Motion* farther communicated, cauſes thoſe Circles on the *Margin* of the Water, ſome bigger, ſome leſs. So in like manner the continual *Motion* of the Particles contain'd in a *lucid* Body, cauſes a ſucceſſive *Agitation* in the *Ma-*

teria Subtilis, from the *Center* to the *Circumference*, 'till meeting with ſome impenetrable *Body* 'tis reflected.

Our *Tenet* in ſhort is, that *Light* is caus'd by the *Motion* of the parts of *lucid* Bodies, by which they are fitted, for diffuſing on all ſides the *ſubtile* Matter, which fills up the Pores of *tranſparent* Bodies. So that Fire carries *Light* with it, becauſe its Particles have this *Motion*, and are moſt thin and continually agitated; for the ſame reaſon all ſparks of Fire, have more or leſs of *Light*. Some rotten Woods ſhine and glitter in the dark, *&c.* and that becauſe their *Particles* are in a conſiderable *Ferment*, (for by *Fermentation*, *Corruption* is produced) which excites an *undulatory Motion* in the *Materia Ætherea*, which cauſes Light in ſuch places as are dark, or where there is no other Light to hinder its effect. From this Motion of the *Particles* 'tis that rotten Wood grows lighter or leſs weighty, ſince ſuch Motion cauſes a diſſipation of the Parts. *Glow-worms*, and ſome *Flies*, have the like effect, which ſome have thought fit to attribute to certain *Exhalations*, not unlike the *Sweat* of other *Animals*, proceeding from them; which may be more probable, ſince we obſerve that theſe *Inſects* are no ſooner dead (when theſe *Exhalations* can no longer be furniſh'd) but their Light is extinct.

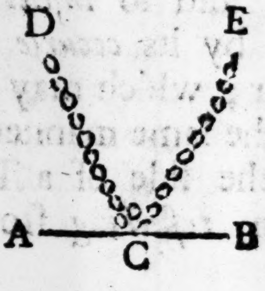
Lucid Bodies, as Experience teaches, ſeem leſs to us the farther we are removed from them. As the *Sun*, which is a *Body* much bigger than our *Earth*, (according to *Aſtrologers*) yet ſeems leſs to us than our Heads; the reaſon for which, I have thought, might be drawn from the loſs of *Rays* proceeding from it; for the *Sun* being many hundred of times leſs than the *Space* wherein Rays are propagated, and no more than the Center (in a manner to the remaining *Space* in the Univerſe) of a Circle to the Circumference, muſt loſe ſo much of its bigneſs, ſince the Rays of *Light* which proceeds from it, run ſtill farther from one another the farther they go, (of which any one's *Thoughts* may form him an Idea) ſo that few only ſtrike on our *Eyes*.

But ſince the *Light* is not always ſent directly to our *Eyes* from the *lucid* Bodies, but oftener reflected and refracted, according to what Objects and Mediums it falls on in its way, 'twill not be amiſs to give here firſt ſome Rules for *Reflections* and *Refractions* in general, and then of *Light* in particular.

Firſt, By *Reflection* we mean the glancing and change of the *determination* of a Body in Motion, at the falling on another which it cannot penetrate: So a *Ball*, determin'd to run a ſtraight Line, if it meet a Wall in its way, is forced to change its *determination*, and glance back, ſo forming a greater or leſs *Angle*, according to the Line it firſt mov'd in, reſpectively to the *Site* of the Wall.

By *Refraction* is meant a *Deflection*, or change of the *Determination* of a Body in Motion, caus'd by its paſſing from one Medium to another, which it penetrates, either with more or leſs difficulty; if with more, it is refracted by drawing from the *Perpendicular*, as 'tis in a Body ſent from the *Air* to the *Water*; for it finding leſs *Reſiſtance* on the part of the *Air*, draws towards the *Horizontal*, ſo changing its *Determination*. On the contrary, a Body ſent from the *Water* into the *Air*, changes his *Determination*, by running towards the *Perpendicular Line*, for the reaſon contrary to the former. To reduce theſe Rules to the *Rays* of *Light*;

Firſt, The *Rays* of *Light* are after the ſame manner reflected as other *Bodies* are; and as a Ball glances back that is thrown againſt a *Wall*, ſo likewiſe the *Rays* of *Light* darted againſt the Surface of a ſolid *Body* fall backwards, as in the ſequent Figure is repreſented; where the little *Globules* in the *Line* D, C, (by which is repreſented a *Ray* of *Light*, or *Particles* of the ſecond



Element) falling on the *Solid* A, B, muſt vary its *Determination* (not being able to paſs the ſolid *Superfice)* by going on from C to E, form a Line of *Reflection* equal to that of *Incidence*, and an *Acute Angle*, in the ſame manner as 'twould be if one only of the *Globuli* was reflected: From the various Reflections of theſe *Rays* 'tis, that the different Colours ariſe, and from the various *Diſpoſitions* of the Surfaces of the *Solids*, the different Reflections.

Secondly, The *Refraction* of the *Rays* of *Light* is quite *inverted*, to that of other *Refractions*; and as any other Body paſſing from a *rarer* into a more *denſe* Element, as from *Air* to *Water*, is *refring'd* towards the *Horizontal*, the *Rays* of *Light* will change their *Determination*, for one nigher the *Perpendicular:* Many Reaſons have been offer'd for this difference, but this beſt contents me, *viz.* that ſince the *Rays* paſs from a *Medium* that has large *Pores*, into one whoſe *Pores* are more ſtreight; from one leſs *ſolid* into one *inflexible*, 'tis probable that the *vibrated* ſubtile Matter is *contracted* by the ſtreight *Pores* of the Water, and ſo *inflected* from its former *Determination*, by its *occurſe* with the *ſolid Particles* of Water; which may be ſuppoſed to be effected after the ſame manner, as a Ball thrown obliquely on the ſide of a Tin-*Tube*, is forced to the bottom, *reflecting* from one ſide to the other.

On the contrary, if the *Undulations* of the *Æthereal* Matter, from a *denſer* Medium, fall on a more *rare*, they are *refring'd* towards the Horizontal Line, becauſe the Rays paſſing the Water are likely to ſtrike on the higher *Particles*, on the Surface, by which they are *infring'd*.

To prove this our ſuppoſed Point of *Refraction*, different in the *Rays* of *Light* from other *Refractions*, take a piece of Silver, and put it at the bottom of a Baſon, not to be ſeen by one looking obliquely into it; then pour in ſome Water, which, as it aſcends, will render the Piece viſible to the Eye, looking at the place above-mention'd; becauſe the Water cauſes a *Reflection* of its *Rays* more towards the *Horizon*, or *Eye* looking obliquely into the Baſon. For an Example of the Rays *Refraction* from Air to Water, let us obſerve the Sun, which as ſoon as ſome of its Rays ſtrike on the Water towards the ſide only of a Well, is repreſented all at the bottom of the Well, its Rays by the Water being refracted towards the *Perpendicular*.

The ſame lucid Bodies, and the ſame Rays which we make to be the cauſe of Light, are likewiſe the cauſe of *Heat*, as the Rays of the Sun, *&c.* which ſtriking on the Surface of our Bodies, encreaſe the Motion of the Blood, by lending it ſome of its *Agitation*; ſo that the greater their Motion is, the more Heat they cauſe.

CHAP. III.

Of Colour, *the ſecond* Object *of the* Sight.

COLOUR is a certain Power in Bodies of affecting our *Organs*, after ſuch or ſuch a manner, whereby ſuch or ſuch a *Perception* is excited in our Mind: This Power is put into Action by the *Intermediation* of the Rays of Light, and conſequently Colour is but Light *reflected* and *modify'd*; for when the Rays of Light are withdrawn, no Colours are perceptible.

This word *Colour* may be us'd, either for a Power which colour'd, or viſible *Objects* obtain of reflecting the Rays of Light after a particular manner; or otherwiſe, for the Light *reflex'd*, as it ſtrikes on the *Retina*, and renders the Object viſible.

Colour depends on the Object, in ſo much, as, according to the different Diſpoſition, Conjugation, and Situation of the parts of Bodies, 'tis, that the different Reflections of the Rays of Light are produced; therefore if the Diſpoſition of the Object be alter'd, the Colour likewiſe will vary, becauſe the Rays will not then be as before reflected; ſo *Chryſtal*, by being broke into ſmall parts, loſes its *Perſpicuouſ-*

neſs, and becomes bright. Wood burnt (tho' before white) becomes black, *&c.*

Again, what reaſon could we bring for the various Colours in the Clouds, which are ſometimes *Red*, ſometimes *White*, &c? To what ſhall we attribute the diverſity of Colours in a Rainbow, *&c.* unleſs to the different Modifications of the Rays of Light, according to the Variations in the *Figure* and *Motions* of the *Particles* of ſuch like Bodies? Neither can any one juſtly deny theſe to be Colours, ſince Colour is but a Power, as above; nor ought it to be concluded, that becauſe ſome Colours are *flaxil*, and not *permanent*, they are not really to be call'd Colours, or without the addition of *Spurious*, unleſs the ſhort durance of the Cauſe deſtroys the *Effect*? Unleſs a Child, that dies as ſoon as born, does not deſerve the Name? And muſt we think that the greenneſs of the Leaves is no Colour, becauſe they ſoon fade and wither? If ſo, I would fain know what Colours there are in the World? I never met with any yet that were everlaſting.

Other different Opinions there are of Colour, as that of the *Peripateticks*, who would have it to be a *ſecond Quality, ſenſible to the Sight, produced from the tempering of the firſt Qualities.* But this Definition leaves us ſtill in the dark, for ſtill the Queſtion remains, What this Quality is? How 'tis produced? From what? When? In fine, the diverſity of Colours is very great, as the Objects of other Senſes are; and as the

Objects

Objects repreſented, as colour'd, vary, ſo do their Colours; which, as they are compounded of a various Diſpoſition, *&c.* of the Parts, they variouſly reflect the Rays of Light; from whence 'tis that *Human* Art, by the many orderings and mixing of *Juices* and *Particles*, &c. firſt got a way of imitating all ſorts of Natural Colours, as his uſe requir'd.

Others define Colour, *Perſpicui extremitas in corpore determinato, ſeu extremitas perſpicui determinati.* Colours therefore have their true *Eſſence*, not from Light alone, but alſo from the differing Conſtitutions of mix'd Bodies, from whence Light is reflected. But now you'll ask, what particular Conſtitution in the Mixture is requir'd for producing ſuch a particulour Colour; or from what particular Compoſition of Parts, an Object is now *White*, now *Black*, now *Green*, now *fulgent* like Gold, now like Scarlet *reſplendent*, &c.

Before we proceed, we muſt know, that there are *ſimple* Colours, and *compound*; the ſimple are the extremes, as *White* and *Black*; and middle, as *Red*, *Yellow*, and *Blue*, which are of a middle Conſtitution between *White* and *Black*; the compound Colours are ſuch as are form'd by the mixture of ſome Simples; the *cinericean*, or Aſh-colour, is a compound of *White* and *Black*; the *Golden-colour*, of *Yellow* and *Red*; the *Purple*, of *Red* and *Blue*; the *Green*, of *Yellow* and *Blue*; the *Livid*, of *Red*, *Yellow*, and *Blue*. All which Colours vary, according to the different mixture of Salts with Sulphurs, Earth, *&c.* where the *Caput Mortuum* moſt abounds, there the mixture turns to a *Dark*, and ſo on.

Experiment. Take the ſharpeſt Vinegar you can get, and pour it into a leaden Plate, leaving it there for ſome days to work on the *Lead*, at the end of which, you will have a *Ceruſſa*, or *Ceruſe*, of the whiteſt Colour; which put into *Crucible*, and place it over a hot Fire, and it will turn into a Red-colour, or to what we call *Minium*; and this likewiſe, by ſome longer duration of the Fire, will be converted into a black *Droſs*. The firſt Colour will be *White*, becauſe the *Acid* of Vinegar, diſſolving the Sulphur of Lead, cauſes a *bulbous* mixture, like that of broken *Chryſtal*. Secondly, this placed over the Fire will turn to a bright *Yellow*, from thence to a graſs *Green*; after into a Gold-Colour, thence to *Red*, or a *Minium*: If after this you urge ſtill with Fire, it will by degrees deſcend to a *Scarlet*, *Azure*, and *Aſh-colour*, 'till at length all its *volatile* Parts, by the vehemence of the Fire, being diſſipated, it wholly degenerates into a *Black*; from whence we ſafely conclude, that, according to the various Concoctions of mixtures, their Colours vary.

Experiment. To the Infuſion of Galls in *lympid* Water, add ſome *Vitriol*, and you will have a good Ink; to this add your *Aqua Stygia*, and your Ink will be again turn'd to the *tranſparency* of Water. Out of the firſt mixture you will have an Ink; becauſe the Galls, which are the impurer part of Sulphur *combuſt*, are extream porous, and therefore fitted for abſorbing the Rays of Light; and coagulated by the *Vitriol*, deſtroy the Tranſparency of Water, by obſtructing its ſtrait Pores, but ſtill leaving indirect Pores, whereby the Rays of Light are admitted; all which, by the addition of *Aqua Stygia* is corrected, becauſe this Water abounding with a corroſive *Alkaline*, again deſtroys the Coagulations of *Vitriol* with the *Galls*.

If you write with the Water wherein ſome quantity of *Vitriol* has been diſſolv'd, your Writing, tho' then it vaniſh, and it is not to be read; yet, by wetting your Paper with the Infuſion of Galls, will again appear legible, as if firſt writ in black Characters.

But to give a nearer Account of Colours in particular, we may imagine white Bodies have a Superficies made of moſt thin Bubbles, reflecting the Light on all ſides; from whence 'tis, that the blackeſt Liquors, if by Agitation, they are froath'd or excited into Bubbles, become white, which view'd with a *Microſcope*, appear wholly *diaphanous*, like bits of broken Chryſtal. Whiteneſs therefore conſiſts in the Reflection of the Rays on all ſides from the Object's Surface.

Black being oppoſite to White, muſt have an *Eſſence* likewiſe oppoſite; and ſince the Eſſence of White conſiſts in the Reflection of the Rays on all ſides, this of Black muſt conſiſt in an unfitneſs of reflecting the Rays of Light, and conſequently black Objects have a Superficies fit for *abſorbing* the Rays of Light, or admitting them into their Pores, ſo that the more of the Rays they admit, the blacker they appear. Hence Wood, by burning turns black, ſince it loſes by the Fire all its Volatile Parts, nothing but the *fixer* Salts, Sulphurs, and *Caput Mortuum* remaining ſafe from the Fire; which forming but a porous Surface, eaſily admit all the Rays of Light that fall on them. Hence likewiſe black Objects in like quantity are lighter than white; as the Coal, then the Wood out of which it was made; black Marble than white, as ſome have try'd.

Yet farther *Experience* proves, that the *Eſſences* of the ſaid Colours conſiſt in the ſuppoſed *Reflection* and *Non-reflection* of the Rays; for if you keep in the *Sun*, for equal ſpace of Time, one black, another white Object, the black will be ſooner, and more hot than the white; ſo likewiſe the Rays of the Sun, collected by a *Convex* Glaſs, will ſooner burn the black than white Object; becauſe ſince, as 'tis ſaid, the white reflects all the Rays falling on its Surface, the black, on the contrary, receiving into its Pores all the approaching Rays, and as one may ſay, extinguiſhing them in its *Subſtance*, by borrowing from them their Motion, has the Foundations of Heat firſt form'd, and then by the ſucceſſive impulſe of the Rays perfected, 'till at laſt it riſes in a Flame, its Particles being put into a violent Motion; whereas, the white Objects reflecting from each Particle, the Rays that fall upon them are not ſo quickly agitated.

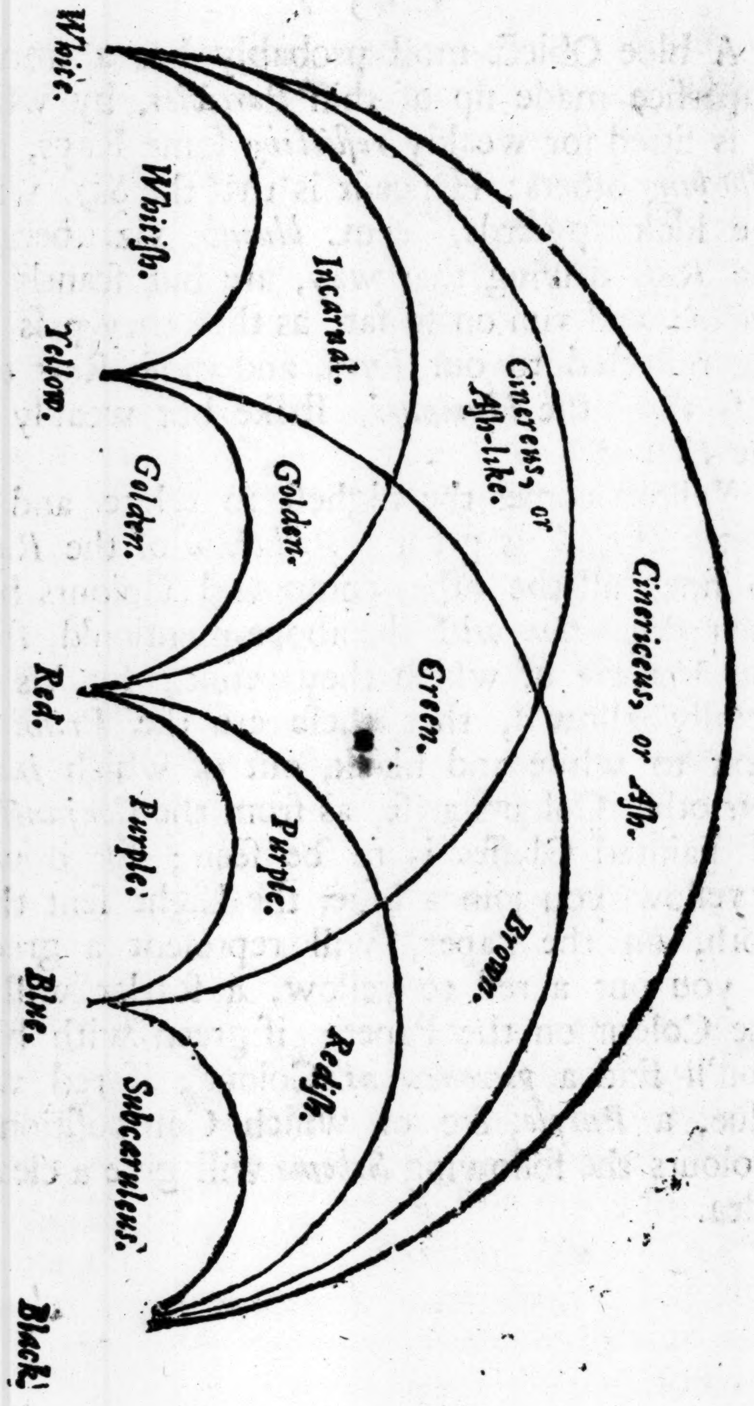
From what has hitherto been noted of black and white Objects, one may gather a Reaſon for a common Obſervation, *viz.* why our Eyes are ſooner tir'd with looking on a white than black Body; or why the *laſſitude* caus'd in us by viewing a white, is remov'd by turning to a black. The Reaſon from our preſent *Suppoſition* of theſe Colours is apparent, for when we look on a white *Object*, reflecting ſo many Rays, which paſſing the *Humours*, ſtrike on the *Retina* without intermiſſion, whereby the *Spirits* are continually ſent to the Brain, and are ſo diſſipated, our Sight is dazled, and loſes its way of clearly perceiving. But if we turn to a dark Object reflecting few or no Rays, the fatiguing Impreſſion being remov'd, the *Spirits* again betake themſelves in juſt *Proportions* into their proper Channels, rendring us again fit for a perfect *Perception.*

A red Body may be ſuppoſed of a craggy Surface, but firm, from whence the Rays are ſent in a *vorticous* and troubled manner; or elſe that its Parts are in a great *Motion*, as all Fires, red-hot Metals, *&c.* which are therefore red, becauſe they couſe this *vorticous Motion* in the Rays of Light reflecting from them. For this reaſon likewiſe the Sea looks rediſh at the ſetting *Sun*; whoſe Rays being *obliquely* ſent on its troubled Surface, are *vorticouſly* reflected, *&c.*

A

A blue Object moſt probably has a ſmooth Superfice made up of thin *Particles*, by which it is fitted for weakly *reflecting* ſome Rays, and *abſorbing* others: Hence it is that the *Sky*, when we look upwards, ſeems *blueiſh*, viz. becauſe the *Rays* driving that way, are but ſcantly *reflected*; and run on ſo far, as that they paſs being reflected to our Eyes, and thoſe *Rays* that paſs thro' the *Humours*, ſtrike but weakly on the *Retina*.

Yellow comes the nigheſt to white, and requires almoſt as great a *Reflection* of the *Rays*: In fine, all the other compound Colours bear their *Proportion* with the above-mention'd, from the *Mixture* of which they reſult; for 'tis generally allow'd, that theſe are the *Primitive* next to white and black, out of which *indefinite* other Colours ariſe, as from the *Conjunction* of painted Glaſſes is to be ſeen; for if with a yellow you join a blue, the Light ſent thro' both, on the Paper, will repreſent a green; if you put a red to yellow, a ſcarlet will be the Colour on the Paper; if green with blue, you'll find a *pavonaceous* Colour; if red with blue, a *Purple*, &c. of which Compoſition of Colours the following *Scheme* will give a clearer Idea.


White.
Whitiſh.
Incarnal.
Cinereus, or Aſh-like.
Cinericeus, or Aſh.
Yellow.
Golden.
Golden.
Green.
Red.
Purple.
Purple.
Brown.
Blue.
Rediſh.
Subcaeruleus.
Black.

In which the Colours contain'd between each *Semi-circle*, are compounded of ſuch as I place at the Points; all which is prov'd by the *Combination* of painted Chryſtal, upon five of which, if you paint the five *Primitive* Colours, you will find the other Colours to proceed from them, by the various *Conjunctions* of them one with another. To explicate the foregoing *Scheme* will be too *prolix*, ſo that I ſhall leave it to the Reader's Ingenuity.

All *Minerals* may be reduced into various Colours, by ſeveral Mixtures; ſo Braſs grows white by being mix'd with the Powder of your *Calx Tartari*; likewiſe, if you throw the Powder of *Allum* and *Arſenick*, firſt waſh'd with the white *Lixivium*, or Lee of *Chalk*, then dry'd into melted Braſs, it will be of a Silver-colour; likewiſe, the Water made out of *ſublimate Mercury*, and diluted with *Salt Armoniack Perdeliquium*, will make the Braſs or Iron extinguiſh'd in it of a Silver-colour. To make Black-Lead white, take of white *Arſenick*, *Chalk* of *Tartar*, Salt of *Gem* and *Armoniack*, and make a Powder, which for ſeven days ſteep in Vinegar, afterwards boil it 'till it be dry, then throw its Flower into Lead melted, and you will quickly perceive the change. Braſs burnt with Sulphur degenerates into a *Cinnabar*. The Spirit of *Vitriol* changes the Colour of Iron into Braſs. Salt *Armoniack* turns Lead into Tin. So of innumerable other *Mutations* of Colours, to be obſerv'd in all the three Kingdoms, *Vegetable*, *Mineral*, and *Animal.*

To this Chapter of Colour, it is fitting we add ſomething concerning *Diaphanous*, or *Tranſparent*, and *Opack* Bodies. Firſt, by a *Diaphanous* Body we underſtand ſomething placed between the Eye and Object, by whoſe *Intermediation*, the Rays of Light are admitted to, and tranſmitted from our Eyes, thro' which all *Light* proceeds, and Colours are ſent; as the *Air*, *Chryſtal*, &c. This *Pellucidity* conſiſts in a great company of ſtreight Pores, with which all *Tranſparent* Bodies are indued; and therefore we gueſs that the *Figure* of their Particles muſt be neat and compact, and their *ſite* Extreme regular. From this may be inferr'd, that therefore the Rays of Light have free Paſſage thro' *Diaphanous* Bodies, becauſe their Pores are direct, and therefore the *Rays* are reflected from *Diaphanous* Bodies, if they ſtrike againſt their *Particles*, becauſe theſe are *impenetrable.*

But the Pores of *Diaphanous* Bodies are rendred unfit for the tranſmitting the Rays, if their *Particles* are indiſpos'd, or put out of their former order: Therefore Chryſtal loſes its *Pellucidity* when brought into Powder, becauſe the *ſite* of the Parts being diſorder'd, the Pores no longer anſwer to the Pores, nor the ſolid Parts to the ſolid; but on the contrary, the Pores to the ſolid Particles, and the ſolid Particles to the Pores; from whence it follows, that the

Paſſage muſt be obſtructed, and the Rays of Light reflected.

All *Liquids* are more or leſs *Tranſparent* ; but thoſe that moſt of all abound with the watry part, are more *Diaphanous* ; but where many Sulphurs and Salts *impregnate* the Liquors, there is always leſs of Tranſparency ; becauſe this *diverſity* of Parts can't ſo exactly agree, but that the ſtreight Courſe of Pores will be interrupted: For this reaſon Water, the clearer it is, the more pure 'tis eſteem'd to be, *&c.*

Opack Bodies are ſuch as reflect the Rays of Light that fall on them, ſo interrupting their Courſe, or farther *Procedure* ; and thro' theſe neither Light nor Colours are tranſmitted to the Eye. To conclude, *Opackneſs* is the oppoſite of Tranſparency, and therefore has an *Eſſence* likewiſe oppoſite ; and as one conſiſts in the Number of ſtraight or direct Pores, the other depends on, and is cauſed by an *Indirectitude*, or *Obſtruction* in the Pores, by which the Courſe of the Rays of Light is hindred.

CHAP. IV.

Of the Nature *of* Viſion, *&c.*

'TIS no ſmall Task to give a good Account of this *Senſation*, the niceſt of all thoſe wherewith Animals have been furniſhed; and in which, we may ſay, the Almighty Hand has given a clearer *Demonſtration* of his infinite Wiſdom, than in any other part of Animal Senſation: But ſince we have already view'd all thoſe parts of the Eye whereon *Viſion* ſeems chiefly to depend; I imagine that we can go thro' this Work with leſs difficulty, and more ſatisfaction; and the Reader having before him the wonderful *Texture* and accurate *Fabrick* of this Senſe, will more eaſily underſtand how it is employ'd.

Viſion is the *Perception* of Objects at a diſtance, after ſuch a manner as they are repreſented to our *Intellect*; which is perform'd by the Rays of Light *intermediating*, (as is above ſhewn) for no diſtant Body can affect my Eye, unleſs it be by the means of ſomewhat between my Eye and the Object; ſo the Sun's Rays falling on a white Wall, are from thence reflected to the neighbouring Parts, where, if they meet an Eye, they excite in it the *Perception* of whiteneſs in that Object: And therefore this is a *Senſation* whereby the Soul of

Animals receives the knowledge of Light, and colour'd Bodies: So that Viſion may properly be ſaid to employ the Soul about Light and Colours, which are the Objects whereon it depends, and without which it fails. In ſhort, as Light is caus'd by an inſenſible Motion of the *Globuli*, compoſing the ſecond *Element*, or *Materiam Subtilem*, borrow'd from an *intrinſick* Agitation of ſome lucid Bodies; as Colours again are form'd by the different *Modifications* or *Reflections* of theſe Rays, and this Light; ſo *Viſion* depends on the preſence of theſe two, and ſinks in their abſence.

Diſputes have been formerly frequent, whether Viſion was perform'd by the *Emiſſion*, or *Reception* of the Rays of Light; ſome were perſuaded that the *Rays* were ſent from our Eyes, by which the Object was enlighten'd, and render'd viſible, or apparent to the Sight; and this they grounded on unfathom'd *Obſervations*; for they found that thoſe Animals which could ſee by Night, as Cats, Owls, *&c.* had *Eyes* that ſparkled in the dark; from whence they inferr'd, that this Light obſervable in their Eyes when Night, was the cauſe they ſaw, when other Creatures, whoſe Eyes were not ſo *radiant*, had no Sight at all; but this Opinion has been long ſince exploded, and therefore does not deſerve another Refutation.

Some will here expect I ſhould give a Reaſon why ſuch Animals ſee in the dark, and others not: I anſwer, Becauſe both the *Cornea*, and Humours, are more tranſparent in theſe, than other *Animals*, but more particularly the *Filaments* of the *Retina* (proceeding from the *Optick* Nerve) are more thin and fine. For ſince (as by *Dioptricks* we are aſcertain'd) all tranſparent Bodies *reflect* ſome Light, even in the Night, tho' much more weakly than at other times: This weak Light will beſt be perceiv'd, or will beſt affect ſuch Animals, as have their Humours moſt paſſible, and Fibres eaſily mov'd, as one muſt allow; therefore it can be no longer a *Miſtery*, that theſe *Animals* in particular have Night-Eyes. Some of theſe Animals which ſee ſo well by Night, have no ſight of *Objects* when the Sun is in our Quarters, becauſe the then too potent *Rays* cauſe ſuch a great Motion in the *Fibres* of the *Retina*, and ſuch a continual *Reflux* of the Spirits, as that the Perception is confus'd, and therefore they are dazled, and can have no good ſight of Objects. But more of this hereafter.

Our now *undiſputed* Opinion is, that the Sight is form'd by *Reception* of the Rays, and that the Eye ſends forth no Light for enlightning Objects; but that Viſion comes from the *Immiſſion* of the Rays of Light into the *Humours* of the Eyes; but how it there cauſes the Sight, ſhall be the Work of the following *Paragraphs*.

SECT. I.

I firſt propoſe that the *Imagines*, or *Species*

Viſivæ, are not really diſtinct from Light *reflected* and *modify'd*; for what do we mean by viſive *Species*, unleſs it be the *Images* of Objects delineated on the *Retina?* And what are theſe *Images*, but the Rays of Light reflected from the Object, *refring'd* by the Humours of our Eyes; and ſtriking on our *Retina*, having thus a Power of repreſenting *Objects* to the Sight? For, Firſt, I ſuppoſe all Bodies are apt to reflect, and modify the Rays falling on their Surface after a various manner, as *Experience* ſhews. Secondly, That all Rays reflected, keep the Rules of vulgar *Reflection*, and form a Line of Reflection, equal with that of *Incidence*. Thirdly, One Ray does not hinder the *Progreſs* of another. Fourthly, The Rays repreſent to us the Colours of thoſe Bodies, from whence they were reflected: So, if in a cloſe Chamber, that has only one Hole whereby the Light is admitted, a piece of red Chryſtal, or Cloath be put before this Hole, and the Rays reflected from it fall on a piece of white Paper, they will make it look red.

From hence I diſpute, that that which paints with its Colours all the Parts of the *Object* in the Eye, repreſents the Object to the *viſive* Power; but Light reflected from each part of the *Object*, paints in the Eye all its parts, as bringing with it the Colour of each part, and therefore I infer, that they repreſent the *Object* to the *viſive* Power; and conſequently the *Imagines Viſivæ* are not really diſtinct from the Light in our

Eyes,

Eyes, ſince without Light they can't be repreſented to the *viſive* Power. We may gather from what has been hitherto ſaid, that Light in its rious Stations, is now taken for Light *ſimply*, now for Colour, now for the *Images* repreſented to the Sight; for the *ſubtile* Matter driven from the lucid Object, thro' the direct Pores of diaphanous Bodies in an *undulatory* manner, is Light; when reflected from *Opack* Bodies, 'tis Colour; when receiv'd by the Eye, after varirious Modifications, 'tis the *Species Viſiva*.

SECT. II.

Viſion is form'd by the Rays proceeding from various Points of a *viſible* Object; ſo as that all the *Rays* from one Point of an Object are ſo inflected in the *Tunicles* and *Humours* of the Eye, as that they join again into one Point at its bottom, and there paint the diſtinct *Idea* of the Object. And firſt of all, the *Rays* which fall on the Eye, that which comes directly from the Object, and ſtrikes directly on the middle Point of the *convex* part of the Eye, paſſes thro' without the leaſt *Inflection*, and is term'd *Axis Viſionis*, or *Axis Opticus*; or elſe the *perpendicular* Ray, as paſſing *perpendicularly* from the Object to the *Pupilla*, and from the *Pupilla* to the *Retina*: The Rays from other Points of the Object, that ſtrike obliquely on the *Retina* are *inflected* or *infring'd* by the Humours of the Eye, ſo as to ſtrike on that part of the

Retina which correſponds to the Point in the Object, from whence they firſt proceeded; for according to the forementioned Rules of *Refraction* of Light, the Rays, from a rarer into a denſer Element, are contracted towards the *perpendicular* Line; and ſo the Rays from the Air coming into the watry *Humour*, and from thence to the *Chryſtalline*, and from this again to the *Vitreous*, muſt be much infring'd, and more than if they paſs'd all the way through one denſe *Medium*; and as the Rays through a *convex* Glaſs are brought all into a Point at ſome diſtance of the Glaſs, ſo the Rays proceeding from one Point of the Object, will be refring'd to one Point of the *Retina*, ſo that there is a double *Refraction* of the Rays; one whereby the *Rays* that proceed from one Point of the Object, and afterwards ſcatter'd, are reduced into one again on the *Retina*; the other, whereby all the Rays proceeding from one Point of the Object are together *refring'd* towards the *perpendicular* Line, or mov'd obliquely along the *Humours*. In ſhort, as the *intermediating* Points of the Object, ſend their Rays to Points of the *Retina* reſpecting them; ſo on the other ſide, one Point of the *Retina* receives but the *Impreſſion* of Rays, driving from one Point of the Object, that when we have a mind to perfectly diſcern the parts of an Object, we direct our Sight and *Axis* of Viſion, ſo as to receive the *perpendicular* Ray from each part of the *Object* ſucceſſively.

Secondly, The *Images* of Objects are painted in our Eyes, in ſo much as our Eye receives the *Impreſſion* from each part of the Object, by the Rays reflected on the Surface and *Particles* of the Object, which, after many *Refractions* perpetrated in the *Humours*, ran into one Point at the bottom of the Eye, *reſpondent* to the Point of the Object, from whence the Rays reflected. So that we may conſider the Object as a *Painter*, the Light reflex'd as the *Pencil*, and the Rays as the *Colours*, by which the *Images* of Objects are expreſs'd. The *Light* reflected from one Point of an *Object* is divided into many *Rays*, whereof one is ſuppoſed to fall *perpendicularly* on the *Pupilla*, the others *obliquely*; which, when they arrive at the bottom of the Eye, *ſociate* again into one Point, oppoſite to that of the Object, by which means they exhibite a diſtinct *Idea* of the Object.

This will, by an Example, be illuſtrated, *viz.* Obſcure a Chamber, ſo that the Light be excluded it, only by one little Hole, which cover with a Glaſs on both ſides *convex*; then place a Paper at ſome diſtance from this Glaſs, on which you ſhall with wonder perceive the *painture* of ſuch Things as are placed before the Hole and Glaſs, as Men, Gardens, Houſes, Woods, Images, *&c.* And from whence can this proceed? unleſs from the *Rays* ſlowly paſſing through this Chryſtal, which paint on the oppoſite Paper the diſtinct Images of ſuch Objects as appear on the outſide of the Chamber, being collected by the *convex* Glaſs into Points on the Paper, exactly oppoſite to thoſe of the Objects they firſt proceeded from; no otherwiſe than in the Eye it happens.

From what hath here been ſaid, we may gather, Firſt, That the Rays ſent from the Object, paint all its *Delineaments* in the Eye, in as much as they communicate to the Eye the *Configuration* of parts receiv'd by their *Modification* and *Reflections*.

Secondly, That Viſion is not perform'd by *Emiſſion*, as *Plato* would have it, of the Rays, becauſe, as *Ariſtotle* retorted, 'twould follow that we ſhould have as clear a Sight of Things in the Dark, as Light; neither could the Eye, without a great *Extenuation*, emit a ſufficient quantity of Spirits to enlighten the Objects.

Thirdly, That an Object placed cloſe to the Eye can't be ſeen, becauſe the Light from it is not reflected to the bottom of the Eye; and therefore 'tis requir'd that there be ſome ſpace between the Object and Eye, to render it viſible.

Fourthly, From the diſpoſition of the Eye and Object, 'tis that *Viſion* is made confuſe, or diſtinct; for as the Rays are reflected by the Object, ſo they ſtrike on the Eye, and ſo they repreſent the Object's Image, unleſs the Eye be indiſpos'd, ſo as the Rays cannot be rightly collected: If the Object be at a conſiderable diſtance, the Eye is made more plain, by the Contraction of the four right *Muſcles*, which

move

move it towards the bottom of the *Orbit*, each on its reſpective ſide, by which the Eye is enlarg'd, and Humours made more plain; from whence a new Collection of Rays is admitted from the *principal* Points of the diſtant Object: If the viſible Body be too nigh, the Eye is lengthned by the *oblique* Muſcles, which being turgid with Spirits, preſs the Eye on its ſides, ſo as to enlarge the ſpace between the *Chryſtalline* Humour, and the bottom of the Eye; for thus the Rays coming from the too near Object may have more room to be collected in, and be united; without which, Viſion can be but very confuſe, becauſe the nigher the Object, the more diſpers'd are the Angles form'd by the *Rays*; the farther the Object, the cloſer theſe are; but the cloſer the Rays are, the leſs ſpace they require to be collected in; and for this reaſon the Eye is ſhorten'd as often as we look at a very diſtant Object; and on the contrary, lengthen'd when we view an Object cloſely, becauſe the *Rays* being more diſpers'd, require more ſpace to be united in. Old Men can't have an exact Sight of near Objects, becauſe their Humours being dry'd, for want of a ſufficient Supply of *Volatile* Salts, *&c.* the *Convexity* of the *Cornea*, and *Chryſtalline* Humour is leſs, and they made more plain; ſo that the *Rays* don't ſo eaſily unite into one Point on the *Retina*, but rather run farther on, and ſtrike confuſedly. They whoſe Eyes ſtick out of their *Orbit*, are ſhort ſighted, or can ſee Objects at a diſtance but imperfectly, becauſe their

Eyes being full and protuberating, the Rays to be *collected* are ſooner united than they ought to be, or before they reach the Bottom of the Eye; ſo that they again diffuſe; and therefore theſe People place the *Object* nearer the Eye, when they have a mind to ſee the *Object* plainly; becauſe the nigher the Body, the more the Rays are detorted, and the ſhorter the *Coni* of Viſion are render'd: Whereas Old Men remove the *Object*, that the Vertices or *Conorum Mucrones* being too long, may be brought together at the bottom of the Eye.

SECT. III.

The *Retina* is a part moſt proper for terminating of Viſion; for what part of all thoſe belonging to the Eye, can be found more convenient, what more fit for this noble Work, than it? Which extended with Straitneſs on the Bottom of the Eye, being opack and thick, eaſily receives and reſiſts the Motion of the Rays; which inſtructed with nerveous *Filaments* (by the various Croſſings of which, it is like a Net form'd) repleniſh'd with Spirits, deriv'd from the *Optick* Nerves, the Spring from whence they ariſe and receive their Increaſe, moſt readily complies with all the Motion of the Rays of Light, and by the *Mediation* of the *Animal* Spirits, conducts the Image of the Object painted on it to the Brain.

This is again amplify'd by *Experience*; for as the Images of Objects are painted on the Paper (as in the above-mention'd *Experiment*) where the Rays, collected by the Convex Chryſtal, form on the Paper plac'd in the dark Room, ſuch *Images* as are repreſented on the other ſide; ſo the Images of Objects are painted on the *Retina*; for we may compare the Eye to the dark Room, whoſe Cavity reſembles that of the inward Chamber; the *Pupilla* is the *Foramen Exiguum* by which the Rays were admitted; the *Tunicles* and Humours may repreſent the Convex Chryſtal; and laſtly the *Retina*, the Paper on which the Rays falling, painted the *Images* of ſuch Things, as reflected the Rays from them to the Chryſtal.

This may be farther confirm'd by a Second Example; for take the Eye of an *Ox*, rob it of its Muſcles, Fat, and unuſeful Tunicles, and place it at the Hole above-mention'd, with its *Pupil* towards the Light, and the *Retina* towards the dark Chamber; which done, you ſhall, after a Recreating Manner, behold the Images of Objects plac'd before the Eye, diſtinctly *delineated* with their differing Colours on the *Retina*.

From hence we may conclude, that Viſion is not (as ſome will have it) form'd where the *Optick* Nerves meet and *inoſculate*, ſince the Rays of Light can't continue their Motion thus far; for this *Concourſe* is near the Brain from whence all Light is excluded.

2. That Viſion is not terminated in the *Chryſtalline* Humour, as *Gallen* imagin'd; for this Humour being extremely tranſparent, can't ſo ſtop the Progreſs of the Rays of Light, as to receive a perfect Painture of the Object's Images. The Rays are not here collected into a Point, but beyond appear confuſe, and not fit to repreſent any Object clearly. The ſame is demonſtrated by the Example of the dark Chamber, in which if you place the Paper any thing nigher the Glaſs than where the Rays meet, you will but have a weak *Repreſentation*, and a cŏnfuſe *Reſemblance* of any Object.

SECT. IV.

The Object's Image being painted on the *Retina*, by the Collected Rays ſtriking on its tender *Filaments*, expanded all along its Subſtance, is by them (inſomuch as any Motion in theſe Fibres produces likewiſe a Motion in the Spirits in them contain'd) carry'd to the Brain, where the *Perception* is by the *Soul* determin'd, which thus only is united with the Body; inſomuch, as it perceives by the *Famulation* of the Animal Spirits, all Motions, whether Regular or Irregular, committed in it; which it furthers, or tries to correct, as they prove pleaſing or not.

It can't be deny'd therefore, but that this, as well as all other *Senſations*, is perform'd by the Spirits *Undulation*; which is to them communicated from the Rays reflected from the *viſible*

Objects, gather'd by *Refractions* they receive in paſſing the Humours of the Eyes, into one Point; by which means they are fitted for a ſtronger *Impulſe* on the Fibre; which being by the Force of the Rays compreſſed and agitated, cauſe a Motion in the *Animal* Spirits, with which they always are turgid; ſo the Spirits contain'd in the Fibres, being mov'd in the place where the Rays fell, move their bordering *Particles*, and they again others, 'till this Motion is likewiſe exerted in the Spirits contain'd in the Fibres of the Brain belonging to the *Thalami* of the *Optick* Nerve; to whoſe firſt Riſe when they arrive, and are able to go no farther, the ſame Motion is communicated to the Fibres by the Spirits, not able to move one another farther; which, by the Rays not able to proceed in their Motion, was communicated to the occurring *Retina*.

But how are theſe *Images* of Objects convey'd to the Brain, by this Motion of the *Spirits?* How can the *Soul*, by this Motion in the Spirits and Fibres of the Brain, judge of the Difference of Colours, and *Nature* of Objects? How does it perceive ſuch a Body to be ſmooth, ſuch another rough, and a third between both? How can it judge one Object white, another black, by this *Agitation* in its Fibres? Is it becauſe the Spirits receive different Motions from the differing Reflections of the Rays? Or becauſe the Rays, as they have more or leſs Force, cauſe a differing *Impreſſion?* *Nothing leſs:* For certainly if the

Rays of Light were from all Objects after the ſame manner reflected, all Bodies would have the ſame Colour; and therefore, now ſince all Objects can't *reflect* or repel the Rays falling on them alike; ſince ſome are diſpoſed to reflect all, ſome none, others more, others fewer, ſome more violently, others quietly, *&c.* ſo likewiſe the *Animal* Spirits will be mov'd according to the Motion of the Rays, ſometimes ſtrongly, ſometimes weakly; ſometimes more, ſometimes leſs, *&c.* from whence the *Soul* may judge what difference there is between ſuch and ſuch Objects: But of this we will diſcourſe more in the following *Chapter*.

CHAP. V.

A ſhort Explication of ſome Phœnomens *for the better underſtanding this* Senſation.

I. OBJECTS appear moſt clearly to the Sight, when the Light is greater, or when the Rays falling on *Opack* Bodies, are the ſtrongeſt; for then the reflected Rays move with greater force the *Capillaments* of the *Retina*; and for this Reaſon, when the Sun declines, all things look dimmer than when it was higher. I have heard of a Young Man who ſaw perfectly well whilſt the Sun was in our *Hemiſphere*; but as ſoon as ever it begun to fall paſt our *Horizon*, could not ſee at all. This I conſider'd for ſome time, and quickly concluded, that it could not be an Effect of any Fault in the *Humours* of the Eye; but that theſe might as well collect the weak Rays as the ſtrong: So that I referr'd it after ſome Thoughts, to the particular *Diſpoſition* in the Fibres compoſing the *Retina*; and imagin'd, that this proceeded from a Relaxation of this *Tunicle* and its Fibres; as Deafneſs, or Hardneſs of Hearing, often is known to be deriv'd from a *Relaxation* of the Drum-skin; ſo, that none but vehement Sounds can be perceiv'd. The ſame here: For ſuppoſing theſe Fibres, compoſing the *Retina*, to be relax'd; 'twill follow, that a little Force will not give a Motion to the Spirits in them contain'd; but there muſt be a ſtrong one at the ſame time to extend the *Membrane*, and compreſs the Nerves: So that to me, thoſe would ſeem the moſt proper Remedies that conduce to the diſſipating of the watry part of Blood which keeps theſe Parts relax'd. Other things there are, which help towards a clear Sight; to wit, the *Tranſparency* of the Humours, ſo as that they do not hinder the Progreſs of the Rays of Light, or retard their Motion: Therefore unleſs you preſerve the Chryſtal of a *Microſcope* from Duſt, *&c.* it will not give ſo clear a Sight of Objects as is expected. Laſtly, The *Dilation* of the *Pupilla* of the Eye; for the more large the *Pupilla* is, the greater quantity of Rays are receiv'd from each point of the Object, whereby it is more diſtinctly delineated.

II. A *Diſtinct* Sight, which is a perfect *Viſion* of a Body in its proper place, ſite with its other Qualities, is produced, Firſt, by the right *Collection* or *Refraction* of the Rays into one Point; for if all the Rays that come from an Object within the Compaſs of the *Pupilla*, be ſo *refring'd* thro' the Humours, as all to meet in one Point exactly where they reach the *Retina*, then the Viſion admits of no *Confuſion*. For this Reaſon we have always a perfect Sight of that part of an Object from whence the *Axis* of Viſion is deriv'd; because theſe going *perpendicularly* thro' the Humours, ſtrikes directly and ſtrongly on the Extremities of the *Fibres*, without looſing much of its Force. Secondly, 'Tis requir'd, in order to a diſtinct Sight, that the *Filaments* or Fibres of the *Retina* be rightly impreſſed; for 'tis not only neceſſary that all the Rays be united on the *Ritina*, but alſo that they ſtrike on as many Extremities of Fibres, as there are Points in the Object from whence they proceeded; for if two Collections of Rays ſtrike but on one Fibre, or the Extremity of one *Filament*, the Sight will be no clearer, than if one only of thoſe Points fell on the *Retina*; for one Fibre can but follow the Motion of one Collection of Rays at once; neither can we ſuppoſe that the *Spirits* can be mov'd doubly at one and the ſame time. We may here ſhew why a Meadow deck'd with Flowers of a red or yellow Colour, looks red or yellow; *viz.* becauſe the Rays reflected together from the Graſs and Flowers, gather into one Point on the *Retina*, ſo as to ſtrike both at once on the Extremity of one only Fibre, which follows the livelieſt Impreſſion; ſo that, that of the yellow or red Flowers being the livelieſt, that is the Colour moſtly repreſented.

III. Why ſome Animals ſee, when the Rays of Light are more faint, and when others cannot, is deducible from the particular *Diſpoſition* of the parts of their Eyes; that is, from the extraordinary Thinneſs and Clarity of their *Tunicles* and Humours; and alſo the greater Fineneſs and Straitneſs of the Fibres expanded along the bottom of the Eye; by which they are better fitted for collecting the Rays, without leſſening their Motion, and alſo for receiving the leaſt *Impreſſion*, and conveying it to the Brain. But of theſe *Animals* which ſee by Night, ſome can't indure that of the ſtronger Sun; becauſe its Motion thro' the Humours and on the *Retina* is ſo great, that it dazles them: Juſt ſo any one that comes from the Dark to a greater Light is dazled, and can't without Pain receive the ſtronger *Impreſſion*, viz. becauſe when one is in the Dark, he dilates the *Iris* and *Papilla Oculi*, that ſo more of theſe Rays which are then reflected, may be receiv'd, in order to a clearer Perception: And for this Reaſon 'tis, that the longer we ſtay in the Dark, the better we diſcern things round us: So that when he comes into a more potent Light, the Rays run in ſuch great number into his widen'd *Pupilla*, and ſtrike ſo vehemently on the ſtraitned *Retina* (for I can't but think that this Tunikle is capable likewiſe of ſome Contraction, as often as the Eye is ſhorten'd, by the Contraction of the right *Muſcles*) that the Spirits are mov'd too violently to their Fountain, *&c.* But after ſome time remaining in the place with this Light, it no longer offends, becauſe then by degrees the *Pupilla* is contracted, and not ſo many Rays admitted; ſo that as often as we change from a Dark to a very Light place, and the contrary, we can't ſee. Firſt,

If

If the change be from the Dark to the Light, becauſe the Eye being much dilated, one is dazled by a too great *Reception*, or *Impulſe* of Rays. Secondly, If we go from the Light to the Dark, we don't ſee, becauſe then the *Pupilla* being contracted, too few of thoſe weak Rays are admitted to give any Perception.

IV. Some one may ask a Reaſon for what they daily *experience*, viz. how it comes that Sight, being wholly caus'd by the *Motion* of the Rays of Light, we ſhould ſee ſo many times the *duplicate* of any Object, if compos'd with our *Pupilla*, or that Hole whereby the Rays cauſing Light are receiv'd. *Reaſon*, that this is a particular Effect of the *Reflection* of the Rays of Light; for Light, filling all Parts, is reflected from all Quarters, and therefore it muſt receive many *oblique* Reflections, by which the *Rays* from diſtanter Points are brought cloſer to one another, and fitted for entring a narrower ſpace; ſo we find, when we look through a ſmall hole in Wood, or any other Thing, we ſee a much larger part of what is under, and on the other ſide, than the Hole we look through; for the *Rays* obliquely, from more diſtant Points, enter this Hole, and coming to the Eye, *paint* the Image of the Object on the other ſide, though twenty times larger than the Hole they proceeded through. Another *Phainomenon* ſeems to depend on this oblique Reflection of the Rays, *viz.* the *Inverſion* of the Object's Image on the *Retina*, which, ſince the Rays muſt neceſſarily come with an *oblique* Deſcent on the Eye, ſeems a meer neceſſity; for the Rays can't be ſo inflected in the Humours, but they will tend yet ſomewhat to their former *Determination*, and conſequently thoſe that came from that ſide of the Object, oppoſite to the right corner of the Eye, will run towards the left, and on the contrary; for obliquely they muſt come, or elſe not light on the *Pupilla:* But yet this Inverſion ſeems again rectify'd; for if we conſider, we ſhall find that the Rays coming from the right of the Object, alſo ſtrikes on the right ſide of the *Retina*, and on the contrary; for ſince we can't ſee any Object but it muſt be oppoſite to us, its ſides muſt be likewiſe otherwiſe than thoſe of our Eyes; its right to their left, *&c.*

V. Some may enquire, how it is that we perceive by the Rays falling on our *Retina*, the Objects, from whence they were reflected, *Situation*, *Diſtance*, *Motion*, *Reſt*, *Figure*, &c. To theſe I anſwer, in ſeparate Paragraphs; Firſt, That we perceive the Site of an Object when we look at it, by the ſole *Impulſe* from a certain Region towards ſuch a part of the Brain; for on that ſide we judge the Object ſituated, on which the Rays ſent from it, affect our Eyes. So if from the top of a Hill I ſee a Houſe at the bottom, I judge it to be ſeat-

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ed in a Valley; becauſe the Rays of Light aſcending to me, ſtrike high on the higher part of the *Retina*, by which the Soul judges this Houſe lower, *&c.* If I look at a Bird in the Air, I judge him higher, or lower, as the Rays reflected from him, and forming in me an Idea of him, ſtrike lower on the lower ſide of the *Retina:* Again, I judge that this Bird flies ſideways, or is on the ſide of me, if the Rays ſtrike on one ſide of the *Retina*, and ſo on; for the Rays coming from an Object, are certain Lines drawn from the Eye to the Object, by whoſe various Impulſe the Soul is brought to judge of their differing Qualities.

VI. The *Diſtance* of an Object may be perceiv'd by the diſpoſition of the *Axis Viſionis*; for the Soul always attending, to the different Perceptions, eaſily determines the length of the *Axis Opticus* by the force it imparts to the Fibres of the *Retina*; ſo that it being firſt known what Colour it is the Object is of, (for according to the Colours, the Impreſſions vary) 'tis quickly judg'd that the Body is ſo far, or ſo near, *&c.* and tho' a black Body does not cauſe ſo great an Impreſſion as a white; yet if we look at a black ten Yards, and at a white twenty, tho' the Impreſſion of the latter be the ſtronger, we yet judge the former the nigheſt, becauſe the Soul firſt knows the difference of theſe Colours; 'tis therefore obſervable, that they who have been long accuſtom'd to judge of *Diſtances*, don't ſo eaſily err, becauſe their Souls have form'd a more perfect Idea of the length of the *Axis Opticus* by the force it imparts. The particular *Diſpoſition* of the Eye does likewiſe conduce to the right judging of the *Diſtance* of Objects; for as is above ſaid, we widen our Eye when we are to view a diſtant Thing, and lengthen it when we look at a very near one; and therefore 'tis probable, as we look at a nigher, or more diſtant Object, the Eye is gradually chang'd: Firſt, for Example, I look at a very near Object, therefore my Eye is lengthen'd, by the *Contraction* of the *oblique* ſurrounding Muſcles; if this Object be carry'd by degrees farther, theſe Muſcles are gradually relax'd, as the Object removes, and at length the right Muſcles begin to widen the Eye, the Object drawing farther from it: This every one may in himſelf obſerve when he looks at a Bird, *v. g.* firſt riſing under his Noſe, and then by degrees leaving him, 'till at length it arrives at a great diſtance from him. Some refer this Appearance to the knowledge of the *Conjunction* of the two *Axes Viſionis*, which may be likewiſe ſome help towards diſtinguiſhing the diſtance of Objects; and for this Reaſon we can't ſo well determine an Object's-diſtance when we view it with one Eye, as when with both. The farther diſtant the Object is, the more eaſily we may be deceiv'd in our Judgment of its diſtance, as any one will quickly conceive.

VII. We judge of the *Magnitude* of an Object by the diſtance of one part of it from another, and by the diſtance of the whole from us; for the diſtance of an Object firſt conſider'd, we find that the Rays from all ſides of an Object cauſe an *Impreſſion* on the *Retina* in the Extremities of more or leſs diſtant Fibres; therefore the farther diſtant theſe *Extremities* impreſs'd are from each other, the greater we judge the Object to be, and on the contrary: So that firſt 'tis neceſſary that we know the diſtance of an Object, before we can attain to the knowledge of the *Magnitude*; and as often as we are deceiv'd in the Diſtance, we muſt be deceiv'd in the Magnitude: And for this Reaſon we can't judge of the Magnitude of the Sun, and Stars, becauſe their diſtance is by us indeterminable; for the farther diſtant an Object is, the leſs is the ſpace between the Points of the Rays, *&c.* And conſequently as oft as we judge an Object nigher us than it really is, the leſs we make it ſeem; and on the contrary, as often as we judge it farther than it really is, we fancy it bigger than it really is.

The Stars, and Moon, by the interpoſition of Smoke, and their Clouds, ſeem larger than otherwiſe they do, becauſe they are judg'd leſs diſtant; they appear larger becauſe the Rays are more collected, and even thoſe that would elſe have run far from the Eye, are refring'd to it by this Interpoſition; ſo that the diſtance in this caſe depends on the Magnitude. The moſt lucid, and ſplendid Objects appear bigger than they often are, by reaſon of the many and potent Rays which they continually ſend forth, which take up a great ſpace of the *Retina*.

The Moon, Sun, and other Planets, ſeem larger, when they juſt touch the Earth in a manner, and are nigheſt the *Horizon*, becauſe, as ſome ſay, we then judge them farther diſtant, and receive more of the Rays proceeding from them.

VIII. The *Figure* of Objects may be drawn partly from their different Colours, partly from their different Reflections, and wholly from the Knowledge of the Site of the diverſe parts of an Object, Diſtance, and Magnitude. But as I imagine, we rather know the Figures of Bodies from their particular Impreſſions; for the Rays proceeding from all the parts of an Object paint all its parts on the *Retina*, and cauſe an Impreſſion in its Fibres, in the ſame order they receiv'd their Reflection; ſo that we know ſuch a Body to be round, becauſe its Image on the *Retina*, form'd by the Impreſſion of the Rays, is round; for the Rays from all the Points of this circular Body, collected by the Humours from a circular, or round Impreſſion. The ſame may be conceiv'd of all other

Figures of Objects, which I think too many to run thro'.

IX. We perceive a Body to be in motion by our Sight, becauſe the Rays from it run continually from the Extremities of ſome Fibres to others, 'till at laſt I am forced to change the Site of my Head and Neck to keep the Sight; by which we are taught that the Object changes its Site: Again, we find it move, becauſe we obſerve its Images join'd ſucceſſively with the Images of other immov'd Objects. To draw nigher, let us ſuppoſe a Bird moving directly from us, we know he moves, becauſe he continually changes from the Line he firſt was in; and we know he moves from us, becauſe we perceive the diſtance between him and our Eye is encreas'd; this, with *Proportion*, may be ſaid of what Motion ſoever we can meet with. Laſtly, Objects are known to *reſt*, when the Eye unchang'd, the Images remain unalter'd in the ſame Line on the *Retina*; in fine, when we no longer obſerve ſuch Effects in Objects, as uſually make them ſeem in motion, we may then judge them in *reſt*, which is oppoſite to *motion*.

CHAP.

CHAP. VI.

The Reflection of Light thro' ſome Dioptrick *Glaſſes of various Cuts; with a ſhort* Rationale *of Looking-glaſſes.*

FOR the better underſtanding of Viſion, I add this otherwiſe unneceſſary Chapter, which, with its Curioſities, I hope will invite the Reader to ſpend ſome time on it.

Firſt, Therefore, if a Glaſs or Chryſtal be cut into many Faces, it will repreſent an Object as many times as it has Faces or Partitions between each Plain; let us for an Example, take one with three Plains, or Faces (for what is ſaid of this may be as well referr'd to thoſe of more) I ſay then, that this will repreſent one Object thrice, becauſe the Rays by this *refring'd*, will by both Faces be ſo diſpos'd as if all the Rays really paſſed all three; for the Rays falling on the right ſide Face, will repreſent the Object entire; the ſame of thoſe that paſs the left ſide, *&c.*

Secondly, A piece of Chryſtal on both ſides *convex*, will collect all the Rays falling on it (if at a juſt diſtance from them) into one Point, like, as we have ſaid before, the Humours of the Eye do; and this is becauſe the Rays (according to the Rules of *Refractions*) from a rarer to a denſer *Medium*, run to the perpendicular Line; and at his exit again, from a denſer to a rarer, to the Horizontal.

Thirdly, A Chryſtal on both ſides *concave*, will, in oppoſition to the former, ſcatter the Rays falling on it, and force them farther from the perpendicular Line; for in theſe the abovemention'd Rule of *Refraction* is obſerv'd, ſo that the Rays falling on it are *refring'd*, as above.

Fourthly, A Glaſs on one ſide *concave*, on the other *convex*, will both collect and ſcatter the Rays; collect them with its *convex*, and ſcatter them with its *concave*, by the former Rules. A Chryſtal on one ſide *concave*, on the other plain, will ſcatter the Rays, but not ſo much as one on both ſides *concave*; a Chryſtal on one ſide *convex*, on the other plain, will collect the Rays, but not ſo much as one on both ſides *convex*.

You find therefore in the firſt of theſe Examples an Object repreſented double, by the means of a ſmall Partition in its middle, by which a partial Diviſion is made of the Rays, ſo as that the Faces have Rays enough falling on them to repreſent the Object (for it is not neceſſary for rendring an Object viſible and clearly ſeen, that all the Rays ſent from it come to the Eye; for this is a thing impoſſible, but only that there be Rays from each Point, or the moſt conſiderable Points in it.)

The ſecond Example is of a *convex* Chryſtal, of which Species are ſome of our *Microſcope* Glaſſes, which repreſent the Object bigger than ordinary, or than without the Glaſs they appear; becauſe, by collecting the Rays it brings thoſe to the Eyes which otherwiſe would never have touch'd the *Pupilla*, ſo that more Points of an Object appear when repreſented thro' theſe Glaſſes than otherwiſe; for the Eye placed at a juſt diſtance from ſuch Glaſſes, receives the Rays in greater quantities, becauſe brought by them in a manner to one Point; whereas, when we view an Object ſimply, without any Glaſs, many of the Rays, from the more inconſiderable Points, are loſt, and we can't have ſo perfect or clear a ſight of others, as not receiving ſo many Rays from them, as thro' ſuch *Microſcopes* we do: When therefore we look at an Object thro' a *Microſcope*, we find it often appears nigher us than it really is, becauſe the Rays by this Collection are made to ſtrike with more force on the *Retina*; then again, it always appears much larger for the ſame reaſon, for certainly if we judge a Body nearer us than it is, we muſt judge him bigger than otherwiſe it appears to be: But 'tis much from the placing your *Microſcope* and Eye, that you ſee an Object ſometimes clearer, and larger, and nigher; ſometimes larger, and more *confuſe*, &c. Old Men ſee better in *convex* Glaſſes than others do, becauſe, as is above ſaid, their Humours being dry'd and waſted, 'tis neceſſary they have ſomewhat to help them to collect the Rays before they come to the *Retina*, that they there may ſtrike all in one Point; but young Men, whoſe Eyes are full and long, can't ſee well with theſe Glaſſes, becauſe they collect the Rays too ſoon for them, or before they come on the *Retina*, ſo that they again *diffuſe*; thus cauſing a confus'd Sight.

Our third Example, of *concave* Glaſſes, makes the ſight of *Objects* more *confuſe*, becauſe by ſcattering of the Rays it drives many, which would otherwiſe come to the *Pupilla*, ſo far as that they paſs it; and thoſe which enter the *Pupilla* are ſo far diſtant one from the other, as that the Rays coming from one Point of the *Object*, can't be brought to one Point of the *Retina*; unleſs in ſuch Eyes as are long and full, for theſe having fuller Humours, the Rays have more ſpace to be collected in; and therefore I imagine, that Spectacles made with ſuch Glaſſes would be no ſmall help to ſhort-ſighted People (ſuppoſing they are accurately contriv'd, and not too *concave*) becauſe they will ſcatter the Rays of Light, as that they will not be ſo ſoon collected as otherwiſe they are; and with theſe Glaſſes I believe they may ſee diſtant *Objects* as well as other Men.

Laſtly, I will give a ſhort Explication of our *Teleſcopes*, which have been found ſo uſeful and beneficial in many Occurrences: Firſt, we find they are made with two Chryſtals, one at each end of the Tube; that which reaches towards the *Object*, and is call'd *Objective*, is more or leſs *convex*; that toward the *Eye*, and call'd *Oculary*, is much *concave*, or conſiderably thinner in the middle than on the ſides. Firſt, the Rays, by the *convex* Glaſs, are collected and gather'd, as is above ſhewn, into a Point; ſo that theſe Glaſſes are ſufficient to collect the Rays for the forming of Viſion without the Humours of our Eyes; (when I talk of collecting the Rays into a Point, Note, that I mean thoſe Rays which come all from one Point of an *Object*.) Secondly, The *concave* and *oculary* Glaſſes disjoyn the Rays again, ſomewhat ſo as to make the Rays at a juſt diſtance, to be collected into Points juſt where they reach the *Retina*, wherefore the *Object* is repreſented diſtinct and large; firſt diſtinct, becauſe the Rays are beſt gather'd into one Point on the *Retina*, as they are reflected from one Point of the *Object*; then large, becauſe the Angles form'd by the collected Rays is large; laſtly, the *Object* appears nearer, becauſe the Rays thus managed ſtrike with greater force on the *Retina*, whereby the Soul is deceiv'd in his Judgment, and upon this account the Magnitude is alſo encreas'd. Theſe *Teleſcopes*, the larger their Chryſtals are, the plainer and larger they exhibit the *Objects*; becauſe thus, they receive more of the Rays of Light proceeding from *Objects* view'd through them: The longer theſe *Tubes* are, unleſs proportionably big, the more obſcurely they repreſent *Objects*; becauſe the Rays collected by the *objective* Glaſs are again ſo diſpers'd as to ſtrike on the ſide of the Tube, and of the *concave* Glaſs: If you look at an *Object* with the *objective* Glaſs next your Eye, the *Object* will appear leſs, and at a greater diſtance; it will ſeem at a vaſt diſtance, becauſe the Eye muſt be much widen'd by the Contraction of the right *Muſcles*, and ſo made ſhorter, that the Rays, collected by this *convex* Glaſs closer to your Eye, be not gather'd into a Point before the *Retina*; it will ſeem leſs, becauſe ſince we judge of the Magnitude by the Diſtance, we muſt likewiſe judge the *Object* very ſmall, becauſe we judge it farther diſtant. In fine, the *Object* view'd thus will appear indifferently plain and diſtinct, ſo that the Rays are not diffus'd on the *Retina*, which is hindred by the Collection they undergo in the *convex* Glaſs.

Seeing the end of this firſt Treatiſe ſo nigh, I thought it might not be ungrateful to the *Reader* (now in ſight of a reſting place) to conſider a little the *repercuſſive* Virtue, and *reflecting* Nature of *Looking-glaſſes*; which, tho' they may ſeem ſelf-explicating Effects, are yet not leſs difficult to be underſtood, than what has been before explicated, nor yet leſs neceſſary; for we find them to exhibit a ſight of any *Object*, which is placed oppoſite to them; ſo that the Rays fall on its Surface, which when they can't penetrate, it being made *Opack*, by the Application of Quick-ſilver, they muſt be again reflected, anſwering the Rules of common *Reflection*, i. e. by a Line equal to that of *Incidence*; therefore if the Line of *Incidence* be perpendicular, that of *Reflection* will be alſo perpendicular; if that of *Incidence* be oblique, the *Reflection* will be alſo oblique; and in this the more oblique is the Aſcent or Deſcent, *&c.* of the Rays from the *Object*; the more obtuſe will the Angle be form'd by the aſcending or deſcending *Reflection* of the Rays from the Glaſs; but the nigher the *Aſcent* or *Deſcent* of the Rays from the *Object* draw to the *Perpendicular*, the more acute will the Angles be form'd by the aſcending or deſcending *Reflection* from the Glaſs, *&c.* Now theſe Glaſſes, as well as all other ſhining Bodies, do therefore by the *Reflection* of the Rays exhibite the *Object* from whence they were ſent, whilſt other colour'd and opack Bodies do not, becauſe they *reflect* all the Rays in the ſame manner as they receiv'd them from the *Object*; whereas, other colour'd Bodies abſorb in their Pores many of the *Rays*, and thus make but a confus'd *Reflection*: Then again, none but very ſmooth Bodies have this Faculty, becauſe where the Surface is craggy the Rays are diſpers'd, and ſcatter'd ſo as to loſe the Image of the *Object* from which they were firſt reflected, and only *paint* in an Eye, if they meet one, their own Image. Metals, the more they are poliſh'd, the clearer is their *Reflection*; but none of theſe are ſo uſeful as Glaſs *mercuriz'd.* Water, when moſt *tranquil*, beſt reflects, *&c.* Glaſſes of all ſorts, if by the Application of opack Bodies made *opackous*, reflect the Image of any *Object*; but *Quick-ſilver* is the beſt for this uſe, as beſt fitting the Pores of Glaſs: So that Looking-glaſſes repreſent the *Object* to the Eye, as the Rays from the very Surface of the *Object*; becauſe they do but reflect the Rays, and in the ſame manner as they fell, both as to the *quality* of *Reflection*, and *quantity* of *Rays*.

Of Looking-glaſſes, there are three more common ſorts, *viz.* Plain, whoſe Surface is on a level, and theſe are the moſt general, and beſt eſteem'd. The ſecond ſort is of *convex*; The third of *concave*; both which, according to the *Object*'s ſite, and the Eye receiving the Reflection, repreſent *Objects* now in ſite, now diſtance, now in magnitude, *differing*, &c.

Plain Glaſſes (with whoſe *deſcription* I ſhall content my ſelf for Brevity's ſake, omitting the others) cauſe no alteration either in the ſite, diſtance, or magnitude of the *Object* they repreſent; becauſe, ſince they are ſmooth and level, they give no other *Modifications* to the Rays but of ſimple *Reflection*, according as they fall on it. Firſt, as to the ſite, it will be repreſented the ſame as out of the Glaſs, *i. e.* in the ſame Line of Altitude, the *Object* ſeems ſo much beyond the Glaſs, as it is on this ſide; becauſe the Rays reflected from the Glaſs run the ſame Lines, and make the Impreſſion on the *Retina*, as they would if the Object were really on that ſide it is repreſented; for the ſite of an Object is diſtinguiſh'd by the *Impulſe* of the Rays from a *determinate* Region, *&c.* as above. Secondly, as to the diſtance the Object is repreſented ſo far beyond the Glaſs, as it is on this ſide, becauſe the *Impreſſion* of the Rays is altogether as ſtrong after as before the Reflection. For a clearer *Idea* of this, ſee the *Paragraph* of Diſtance. Thirdly, we ſee the magnitude of an Object the ſame as it really is, becauſe the Line of Reflection, from the Glaſs, being exactly equal with that of *Incidence* from the Object; the Rays from the remoter Points of the Object, will be as far diſtant from each other then, as they would if the Object were really in the place 'tis repreſented. In fine, as 'tis before ſhewn, as long as we are right in our Judgment of the diſtance, we ſhall not err in the magnitude.

Let us here ſee why an Object, when view'd with both Eyes at once, does not appear *double*; a Reaſon by ſome is immediately given, *i. e.* the *Sympathy* and *Analogy* which is between the two *Optick* Nerves effects it: But to conſider it nearer, we are by *Anatomy* taught, that the Nerves of each Pair have in the Brain their *Thalami*, not ſeparate from each other, *i. e.* that the Nerves of one Pair, tho' diſpers'd thro' oppoſite parts of the Body, are ſtill conjoyn'd in the Brain; ſo that the Rays impelling both *Retina's* at once, and cauſing a *Motion* of the Spirits in both Nerves contain'd, yet theſe Spirits move together the Fibres of the Brain *ſubſervient* to this *Senſation*, in the ſame manner as they could, if the Reflux had been but thro' one only Channel; and ſo whether we view with one or both Eyes an Object, it is ſtill the ſame, unleſs that we often ſee perfecter with both than one.

It may be here noted, that the Image of Objects (as ſome have held) is not delineated on the Glaſs, for all the Rays fall here confuſedly, as they do on any other Body; whereas, the Image of an *Object* is only form'd by the Modification of the Rays, when they are collected into one Point, juſt ſo as when they firſt came from the Object; a Looking-glaſs therefore reflects the Rays ſent from the Object, ſo as they, when collected into Points by the Humours of the Eye, may form the Object's Image on the *Retina*.

A
TREATISE
OF
HEARING.

CHAP. I.

Of the Ear, *or Organ of* Hearing.

THE Ear is the Inlet of Sounds, or Inſtrument of Hearing; it has Parts external and internal: Among the external is placed the *Auricula,* or *Patula Cartalaginoſa,* of a Subſtance leſs *ſolid* than a Bone, but yet ſomething more *compact* than the Fleſh, and fitter than either for the Work it was deſign'd; ſince, if ſofter and more participating the Nature of Fleſh, 'twould rather, by yielding,

ing, break the force of the Sound, than conduct it to the inner *Cavity*. You may divide the *Auricle* into the *Superiour* and *Inferiour* ; the *Superiour* is the *Cartalaginous* Subſtance we ſpeak of, *Anfractuous* and *Tortuous*, for the better collecting the wandring Sounds, and gathering 'em in its *Sinus's* and *Meanders*, that ſo more of the Motion may be continued to the *Drum*. The *Cavities* of this Part lie too open to the Sight, to want an Explication, but to give an Account of the hard Names impos'd on each, would be unprofitable: Their Hearing has been obſerv'd to be moſt *acute*, who have this Part moſt *prominent*; for by ſo being, it better receives the *vibrated* Air, and therefore they (whom Chance has depriv'd of this part of the Organ) by forming with their hollow Hand a *Cavity* before their Ear, perceive much better than otherwiſe the approaching Sounds. The *Inferiour* part, or *Lobe*, is a *Carnous*, and ſoft Subſtance, made no doubt for ſome more peculiar uſe than is commonly attributed to it, ſince the Wiſdom of God doubtleſs directed him in his Works, and therefore nothing can be vain.

Both parts of the *Auricle* have their proper Veſſels, as *Arteries* from the *Carotidal* Branch, which ariſes from the *Storta* with the *Subclavians*, where the remainder of the *Storta Aſcendens* is divided into the right and left *Carotidal* Branch ; the *Carotides* therefore are diſpers'd thro' the Organs of Senſe, and the Brain. Veins, that *abſorb* the Blood brought to this Part for its Nouriſhment, *&c.* through it into the *Jugulars*, being there terminated. *Nerves* are hither deriv'd from the ſecond *Cervical Pair*.

The Muſcles of the *Auricle* are Four, which are extream ſmall in Man, whoſe Ears have ſcarce any viſible Motion: But in other Creatures, whoſe *Auricle* is commonly larger, they are more conſiderable, and their Motion more ſenſible. The firſt of theſe Muſcles is call'd *Attollens*, and moves the *Auricle* upwards, and forward; the ſecond, *Detrahens*, and draws downward, and backward; the other two move the *Auricle*, one backward t'other forward; and one is ſtil'd *Adducens ad Anteriora*, t'other *Ad Poſteriora*. Others will have the Muſcles of this Part to be but Two, but whether ſo, or otherwiſe, I ſhall not diſpute.

The *Cavities* of the *Auricle*, by degrees, decline, growing deeper towards the place where they terminate; it's in moſt Cavities that has certain *Glands*, by which a *viſcid* Matter is *ſecern'd* from the Maſs of Blood, bitter and clammy, which hinders the ſmaller *Inſects* from attempting this Paſſage by its bitterneſs, being offenſive to them, and by its *viſcidneſs* entangles, if any are ſo bold as to venture.

The *internal* part of the Ear is not leſs worth our Conſideration than the *external*; it begins at the *Meatus Auditorus*, which is a winding *Duct*, partly *Cartalaginous*, partly *Bony*, whoſe

Skin

Skin is furniſh'd likewiſe with certain Glands, by which the aforeſaid *viſcid* and *glutinous* Subſtance is tranſcolated. This is the way the Sound takes towards the *Drum*, placed at its farthermoſt end.

The *Drum* is cover'd with a Membrane, nervous and pellucid, ſurrounded by a bony Circle; it is of a moſt exquiſite Senſe, and ariſes, as ſome think, from the *Pericranium*, tho' others derive it from the *Dura*, a third from the *Pia Meninx*, a fourth from the ſoft proceſs of the *Auditory* Nerve; but moſt probably 'tis made in the very firſt Formation of the *Fœtus*: This *Membrane* is hard and dry, moſt fit for the Work it is employ'd in; it is ſomething convex on its inſide, as drawn that way by a Muſcle from the handle of the *Malleolus*; which Muſcle, if it loſes its natural Spring, this Membrane will likewiſe become more relax, and leſs fit for receiving the Impreſſion of more moderate Sonnds. Two Examples of this are found in Dr. *Willis*, in his Chapter *De Audita*; one, of a Lady that could hear no longer than a Drum was beat in the Room where ſhe was; the other, of a Man that took up his Lodgings near a Steeple, becauſe he could hear no longer than the Bells were a claſhing. The *Deafneſs* of both which Perſons, doubtleſs depended on the Relaxation of this Muſcle, and conſequently of the *Tympanm*; and therefore the Sounds, unleſs very great, could not ſufficiently extend it, to cauſe any Impreſſion; but when, in the firſt, it was ſtretch'd by the Air, fibrated from the beating of the Drum; and in the ſecond, by the Air impell'd by the Motion of the Bells, it was capable of receiving the Impreſſion of Sounds, which it could not before. The uſe therefore of this Muſcle is not ſmall, for this being contracted, we more eaſily hear little Sounds, and this being dilated, the force of the greater is broke. The *Tympanum* is employ'd in keeping out all Inconveniences of Cold, *&c.* and in admitting, and ſomewhat modifying the vibrated Air; as a Window to ſhut out the Injuries of the Weather, and only to let in the Light.

If you remove this *Membrane*, a Cavity will come into ſight, round beſet with Bone, and lin'd with a Membrane conſpicuous for its Veſſels: Here it was that *innate* Air was placed, imagin'd neceſſary for communicating the Sound to the inner Parts; but it has been thought otherwiſe, ſince the *Aqueduct*, reaching from this Place to the Mouth, was firſt obſerv'd, for by this the Air has a Paſſage to the *Drum*.

In the Cavity of the *Drum* are three Bones fabricated with no little Artifice, and articulated one within another. The firſt of theſe is call'd the Hammer, in Latin, (*Malleolus*) whoſe Head, by a looſe Ligament, is joyn'd to the *Incus*, its ſlender Neck adhears to the *Tympanum*;

panum; it has two *Proceſſes* nigh its middle, to the longeſt of which, the Tendon of the Muſcle above deſcrib'd, is faſtened. The ſecond, is the *Incus*, or *Anvil*, from its ſimilitude, to whoſe Head the Hammer is faſtened; it has two Feet to the ſmalleſt, but to the longeſt of which, the *Stirrop* is ty'd by a firm Ligament. The third is the Stirrop, or *Stapes*, ſo call'd from its reſembling a Stirrop, and is connected by a double Ligament to the *Os Petroſum*; it has likewiſe an Hole in the *Labyrinth*. All which Bones ſerve, by their Motion, to convey the Vibrations of the Air to the little Fibres, proceeding from the ſoft *Proceſs* of the *Auditory* Nerve.

A ſecond Cavity of the internal Ear, and the next to this already deſcrib'd, is the *Labyrinth*, leſs than the former, *perforated* in two places; one of which is call'd the *Feneſtra Ovalis*, the other *Rotunda*, both opening into the Drum, one of 'em being clos'd by the *Baſis* of the Stirrop-bone; other Holes there are from theſe Cavities, for the paſſage of Fibres of the *Auditory* Nerve.

The third Cavity of the *Cochlea*, ſo call'd from its *Speral* Windings, all which are cover'd with a Membrane, form'd by the Fibres of the *Auditory* Nerve.

The *Nervus Auditorius*, or *Par Sextum*, conſiſts of two Branches, the uppermoſt call'd the ſoſt Part, or *Portio Mollis*, the other the hard, and *Dura Portio*; the ſoft Portion is all beſtow'd on the Organ of Hearing, and all the Cavities; for this is the moſt eaſily mov'd by the impelling Air. The *Portio Dura*, for the moſt part reaches to the external Parts of the Ear: This Nerve proceeds thro' an Hole of the *Os Petroſum*.

CHAP. II.

The Nature *of* Formation, *and* Diverſity *of* Sound.

SOUND is an Object of Hearing, and conſiſts in the *trembling Motion of the Air vibrated, and forced on, in an undulatory manner, by a Motion produced in other Bodies*; I ſay, in an *undulatory* manner, for this is the only Motion it is capable of receiving; for all places being *repleat* with Air, we can't conceive what Motion one *Particle* of Air can have, but what it muſt immediately communicate to its neighbouring *Particle*, and that again on, unleſs they were able to penetrate one another. This *Undulation* in the Particles of the Air, is caus'd by a *Motion* in other Bodies, ſince of themſelves they tend to Reſt.

If we dive a little farther, we ſhall find the word *Sound* may be taken two different ways; for either we may take it for the *Senſation* we have, when *ſonorous* Bodies make their Impreſſion on our *Organ*, or elſe we may conſider it, as a Power proper to *ſonorous* Bodies, of exciting in us this *Senſation*. If we underſtand it in the firſt Signification, Experience will be our beſt Teacher and Explainer; yet one thing we may mark, that all are not alike affected with the ſame Sounds that one hears perfectly, what another can't, or at leaſt but faintly perceive. If we conſider it in its ſecond meaning, *i. e.* as a *Power* peculiar to a *Bell*, *Cannon*, &c. of exciting in us this Senſation, we ſhall find it comprehended under our foregoing *Deſcription:* And farther, that Sound conſiſts in Motion, is prov'd by Reaſon, and grounded by Experience; for Sound conſiſts in that, the Exiſtence of which being ſuppoſed, Sound exiſts; the Exiſtence of which being remov'd, Sound cannot exiſt; but ſuppoſing a Motion in the Air, Sound exiſts; this withdrawn that cannot ſtand, otherwiſe than a Houſe without a Foundation. That Motion alone is capable of cauſing Sound, daily Experiences evince, and that without Motion there is no Sound, by the ſame Rule, we are as certain; for you may eaſily obſerve a Sound, caus'd by many Bodies, which have no receiv'd other Modification, than that of Motion. So if any one moves the inſide of his *Ear*, he perceives a Sound. Secondly, if you rub the Hairs of a Bow-ſtring with *Roſin*, or any other thing that will render 'em rough, they will cauſe a Sound, if rub'd on the Fiddle-ſtrings; becauſe by this *Roſin*, there are form'd certain Notches or Teeth in the Surface of the Hairs, which receiving the Strings of the Fiddle, move 'em *reciprocally* from the place they before were in; by which the Air muſt likewiſe be *reciprocally vibrated* from the place it firſt was in, by the Strings driven into that place; but if you wet your Hair with any fat, *oleous*, or *ſulphureous* Body, they glide ſmoothly over the Strings, without moving 'em; ſo that no Sound from hence *reſults*. Thirdly, If with your Finger you rub the Margin of a Glaſs, of any Liquor, there ariſes a Noiſe, or murmuring Sound, becauſe by this *perfricating* the Margin of the Glaſs, you *excite* a trembling Motion in the *Particles* of the Air, caus'd by the trembling of the Liquor contain'd in the Glaſs; for if you rub the brim of the Glaſs, without making the Water therein contain'd to tremble, you cauſe no Motion in the Air, and conſequently no Sound. Fourthly, Any one that is nigh a Bell when it rings, by holding a Hat in his hand, may perceive the Motion the Bell gives the *circumambient* Air, by the Motion of the Hat in his hand; which Motion of the Hat, laſts no longer than that in the Bell and Air.

Ariſtotle has not omitted this Chapter, but defines Sound to be a *local Motion of ſome Bodies, and the Medium, which is apply'd to our Organ of Hearing*; which ſome of his Followers have ſtriv'd to interpret otherwiſe than the words will bear; imagining Sound to be different from *local Motion*, which Opinion I ſhall not ſtay to examine, but rather proceed.

Sound therefore is caus'd by Motion; for two Bodies can't be thrown one againſt the other, but the ſurrounding Air muſt have likewiſe ſome Motion, and be forced in a *vorticous* manner round their *Surface*, and in an

Orb; for the Air being forced from that ſide the Bodies move on, drives to another where it finds leſs Reſiſtance; but it finds leſs Reſiſtance on that ſide the Body came from, therefore it goes that way, and there it ſtill receives more Motion from the Air ruſhing in on all ſides, filling the places the Bodies left. Secondly, The Air thus mov'd by the *Impulſion* of the Body, communicates its Motion to its neighbouring *Column*, which is continued on 'till by degrees loſing it, the Air again reſts. Thirdly, If this Air, continuing its Motion, meets an Ear in its Journey, it inſinuates it ſelf, and ſtrikes on the *Tympanum* according to its Motion.

Sound is better perceiv'd beyond thin and porous Bodies, than more denſe and compact, becauſe thoſe don't ſo much reſiſt and break the Motion of the Air, but give it a more free Paſſage thro' its larger Pores; which can't be expected in compact Bodies, whoſe Pores are in a manner *inconſpicuous*. If you hold your Ear nigh one end of a piece of Timber, while ſome one with a Stick ſtrikes the other, you'll hear a greater Noiſe than you would in the place where the Timber was ſtruck, becauſe the Air contain'd in the Pores of the Wood has not ſo great a *Preſſion* from the *Atmoſphere*, as having leſs Communication with it, than the external Air, by which means it is better able to preſerve its Motion in the ſame quantity it received it; then again, we may conſider this Air contain'd in the Pores of the Timber more pure, and ſooner *agitated* by a leſs Motion of other Bodies more pure, becauſe it has not ſuch a quantity of groſs *Exhalations* commix'd with it; and ſecondly, more ready for Motion, becauſe more refin'd, and not ſo much entangled, but made up of leſs and more agreeing Parts.

2. A Man under Water can't ſo well hear as above, becauſe the force of the Air is broke on the Surface of the Water, and glances back in a manner; or rather one can't hear under Water, becauſe of the continual murmuring Sound the Water makes by *impelling* the Particles of the Air contain'd in the *Meatus Auditorius*; for under Water one has always a perfect *Tinnitus Aurium.* But yet ſome there are that affirm they can perceive Sounds under Water, as the claſhing Noiſe of Stones thrown together, and alſo the Noiſe the Fiſh make in their Courſes, which muſt be caus'd, one would think, by the Circles of the mov'd Water impelling the Air contain'd in the *Meatus Auditorius*, and other *Cavities*; for the Particles of the Water mov'd after an *undulatory* manner, moves its neighbouring Particles, as in the Air I deſcrib'd. An Example of this *undulatory* Motion is ſeen in the Margin of the Water mov'd, which runs on in Circles, one larger than another, 'till it meets with ſome Oppoſition ſufficient to ſtop its farther Carree.

3. The Action of Light is quicker than that of Sound, *i. e.* the Light is ſooner convey'd to our Eyes, than the Sound to our Ears; we firſt ſee the Lightning, and then hear the Thunder; we ſee the Flaſh of the Pan before we hear the Gun's Report; we ſee the Motion of a Hatchet, *&c.* before we perceive the Sound caus'd by the blow; becauſe the *Medium* by which we ſee, to wit, the *Materia Subtilis*, conſiſts of Particles much leſs, and more *ſolid*, than the Air, the *Medium* by which we hear; and conſequently the Motion of this is much leſs than of that, ſince there is more Force required for the overcoming the Reſiſtance of a greater than a leſs Body; for that again loſes a great deal of Motion, in conquering the Reſiſtance of the Body it meets with, as is clear; therefore the Air, whoſe Particles are *intricate*, and, as of other *ſulphurous* Bodies, entangled one with another; and likewiſe in *magnitude*, a little World in compariſon with thoſe of the ſubtile Matter (whoſe very Name forces one to imagine ſomething the moſt minute) can't be mov'd with equal ſwiftneſs, as the *Materia Subtilis*, whoſe Particles are both extreme ſmall, *ſolid* and *inflexible*, and therefore move moſt nimbly, and longer retain their Motion.

4. The Wind conduces much to either our better or worſe *Perception* of Sounds, accordingly as it favours or reſiſts the Motion in the Air; ſince if the Wind favours, it forces on

the Air faſter than otherwiſe; if it be adverſe, it *repels* it, ſo that if the Wind be conſiderable, it often quite ſtops the Air, and deſtroys the Sound we ſhould otherwiſe perceive.

5. A vehement Sound is ſometimes obſerved to deafen, becauſe the Vehemence of the Sound proceeds from the violent *Agitation* of the Air; but the Air, the more it has of Motion, the more it imparts to the *Tympanum*, by which this *Membrane* (if the Sound be unexpected, for then the Air being unprepared for ſuch Impreſſion, *i. e.* the *Tympanum* being much extended by the *Contraction* of the *Muſcle* above deſcrib'd, is moſt eaſily *relax'd)* ſuffers often a *Relaxation*, ſometimes a *Diſruption*, if it only loſe ſomething of its antient Stretch, it only can receive the Impreſſion of great Sounds, as of ſuch as at firſt *relax'd* it, becauſe only theſe ſufficiently *diſtend* it; if it be intirely broke, the hearing is loſt, ſince the Air can be no longer *modify'd* as it ought to be, and is therefore render'd unfit for moving, or *compreſſing* the *Auditory Nerves*. How the *Tympanum* can be *relax'd*, any one that conſiders how the Air ſwells a Bladder beyond its natural Limits, will readily conceive. From the greater or leſs *Diſtention*, and natural Stretch of this *Membrane*, 'tis that one hears better than another. Laſtly, that the Air has ſufficient *Elaſticity* and Force to caſt ſuch a *Relaxation* in the *Tympanum*, or *Diſruption*, as is above deſcrib'd, we ſhall find, if we conſider, how

the Sound of Cannons, or Thunder, often breaks the Glaſs-windows, by its violent Agitation.

6. A Sound aſcends with more eaſe, than deſcends, therefore is better heard by one above, than below the Place, from whence it was *propagated*; a Reaſon for this will not put us at a great ſtand, ſince every one knows, that the Air the higher it is, the more pure and refin'd it muſt be; and therefore on your extream high Hills the Air is too rare to ſatisfy the work of Reſpiration, that ſome are even forced to dye on 'em for want of Breath; the Reaſon for which I ſhall leave you to ſpeculate, ſince there are ſo many different Sentiments about the uſe of *Reſpiration.* But on the contrary, the lower you go, the more groſs you'll find the Air, as always *replete* with the thick *Exhalations* from the Earth and Waters, which cannot get the *aſcendant*, 'till by the hot Rays of the Sun they are reduced to ſome leſs Bulk; ſo that the Air muſt be more pure to mount higher, which Purity from its Motion it acquires, 'till when *preſſus eſt gravitate ſuâ*, and can't gain the *aſcendant* Columns; *neque enim ad aſtra mollis è terris via.* Now that the Sound is beſt convey'd by the more thin Air, I leave to judge by what was above ſaid.

7. The wondrous *diverſity* of Sounds, ariſes from the diverſity of ſonorous Objects; the Strings of a Harp, the ſtreighter they are extended, the *acuter* Sound they cauſe, and on

the contrary; and this happens becauſe the ſtreighter the Cords are, the ſhorter will the *Interruptions* be between each ſtroke, and they ſtrike the Air more ſuddenly and violently. An *acute* Sound is caus'd by the quick and uninterrupted Motion of the Air, when it is continually imparting its *Vibrations* to the Organ: A *dull* Sound, when the Ear is not ſo frequently impell'd, or receives but ſlow Impreſſions from the Vibrations of the Air; upon the ſame account, the more or leſs *equal* the Vibrations are, the more or leſs pleaſant will the Sound from hence reſulting be; for if the *Vibrations* be *equal*, the Impreſſions will be likewiſe *concordant*, and therefore the Spirits reflux; from whence always proceeds a grateful Senſation, or Harmony: Whereas, if the Motion of the Air be *uneven*, and ill-tim'd, it cauſes, for the contrary Reaſon, an harſh Sound, and ungrateful Senſation. A Sound from a rough Surface is harſh and ungrateful; becauſe the Air does not come at the ſame time from all the parts of the Object, and therefore excites a *grating* Impreſſion by its reiterate and unequal *Impulſes*. The greater or leſs is the force of the impell'd Air, the higher or lower a Sound it will cauſe from the greater or leſs *Impreſſion* on our Organ of Hearing.

8. A Harp, whoſe Strings are moved from their ſtreight to a crooked Line, cauſe a Sound, becauſe by their *Elaſticity*, betaking themſelves to the contrary ſide, from that they were

drawn to, in a *precipitating* manner, they deſcribe a Line on this ſide likewiſe *ſemicircular*, and ſo on; by which nimble and ſtrong Motion they agitate and vibrate the *occurring* Air, and give it on all ſides a trembling Motion, which, being brought to the Ear, excites an acute *Impreſſion:* After this manner all other ſtring'd *Inſtruments* cauſe a Sound more grave, or more acute, according as their Strings are more lax, or ſtreight; by which *Modifications* of the Strings, their Senſation and Reſtitution is quick, or otherwiſe.

9. Bells, likewiſe from their *Elaſticity*, borrow their Sounds, and are compoſed of the moſt *elaſtick* Metals; for they are no ſooner driven outwards, on that part the Clapper falls, but they immediately return; to prove this, place your hand on the ſide of a greater Bell, that has been ſounded, and you will immediately diſtinguiſh its *Elaſticity* by its ſtupifying your hand. All hard Bodies have their Sound from their *Elaſticity*, and the more *elaſtick* they are, the more they have of this Quality; for the more conſiderable their Bent and Reſtitution is, the greater Agitation they give the *Particles* of the Air.

10. The roaring Sound of a Cannon, is deducible from the ſame Rules; for the Powder fired, dilates it ſelf to that degree, as to be able to fill a place, a thouſand times bigger than it before did; by which vigorous *Dilations*, it not only drives the Ball before it, but like-

wiſe the Air, forcing thoſe Particles which bordered on it, on others: For 'tis hard to conceive the Powder could be thus expanded, without a place, or ſpace for its *Expanſion.* Now that no part is void of Air, I need not diſpute, therefore it is dilated, by forcing the Air from the place it dilates it ſelf in, by which a trembling Motion is caus'd in all the Air around, and no ſmall one, as may be gather'd from the violent Motion of the Powder, and force it drives the Ball before it. In fine, we may conſider two Motions in the Air, the firſt caus'd by the *Exploſion* of the Gun-powder, the other by the thick Particles of Air forcing on to the place where the *Exploſion* was made, to gain the place from whence the thin Air was excluded, ſince there is the leaſt Reſiſtance, from which different and vorticous Motions, the Sound has its longer *continuance.*

CHAP. III.

Of the Perception of Sound.

HEARING certainly deſerves the preference next our Sight, and it is more Noble than the following, as being the In-let of Knowledge and Diſcipline, without which Society is ruin'd, and 'twould be as well, *belluarum more vagari*, as to live together without Knowledge and Converſation: Without this, 'twould be impoſſible to cultivate our Minds, ſufficiently for ones own Entertainment; no Art, no Science, would ever have been brought on the Stage, things too ſublime for any ones Mind to hammer out to himſelf, which if he did, would be bury'd with him; but as yet we have no Art or Science, that was by the *Inventer* ſo perfected, as we ſee this preſent day they are, but they, by being deliver'd in Writing, and by Mouth from one to another, have been lick'd into a *Form*, their firſt Maſter, by reaſon of the weakneſs of Humane Capacities, and the ſhortneſs of Life, was incapable of bringing 'em too, for 'twas no doubt,

Per varios uſus artem experientia fecit,
Exemplo monſtrante viam.——

Having already conſider'd the Nature of Sound, and its manner of Formation, we have now to conſider how it affects our *Organs*, and cauſes the *Senſations* we continually experience. But firſt, as we obſerv'd, as often as ſolid Bodies are ſtruck one againſt another, they cauſe a *Sound*, by raiſing a trembling *Motion* in the Air, which is mov'd round 'em in manner of an Orb; ſecondly, from this Motion of the Air, next the Surface of the agitated Bodies, the Air is vibrated by its undulatory Motion, as far as the *Vis Movens* carry it; thirdly, this agitated Air occurring with an Ear, inſinuates it ſelf into the *Meatus Auditorius*, impells the *Tympanum*, which being mov'd after the ſame manner, moves the *innate* Air, and the three little Bones, and they the *Auditory Nerve*; fourthly, this *Nerve* being compreſs'd, a Reflux of the Spirits in it contain'd is excited, which moving the Fibres of the Brain, gives occaſion to the Soul of judging a Sound, *&c.*

We might here run over the uſe of each part of this Organ, but ſince they are already ſo well known, I need ſay no more, than that the *Tympanum* being impell'd, communicates its Motion to the Air, and the Bones below deſcrib'd, and they to the other *Cavities*, and the Fibres diſperſed thro' each of 'em, after the manner in the foregoing *Treatiſe* deſcrib'd; and therefore theſe two Senſes differ in their Objects and Mediums, and alſo are perceiv'd in differing parts of the Brain. So that our Soul diſtinguiſheth the difference of *Perceptions*, partly from the diverſity of the Motion of the *Spirits*, and partly from the *Fibres* mov'd, peculiar to each *Senſe*; for the Motion of the Spirits, and from them of the Fibres of the Brain, depends on the *Impreſſion* of the Objects; and the difference in the Fibres, ſubſervient to each *Senſation*, depends on the particular *Structure* and *Fabrick* of the Brain.

Thus much for the *Organ*, *Object*, and *Formation* of Senſations by this Senſe; it remains that we explain ſome *Phænomena's* about it. But one thing we may Note by the way, that tho' the Ears be ſtop'd, one can hear (if the Mouth be open) the Air getting in by the *Aqueduct*, and moving the *Tympanum* after the manner it does if it had its paſſage thro' the *external* Ear; hence proceeds a *Diagnoſis* in ſurdity, for if the deaf Perſon can hear the Noiſe of a *Lyre* when he holds its handle in his Mouth, you may ſuppoſe that there is no fault in the *internal* parts, but that the *Deafneſs* is caus'd by ſomething in the *Meatus Auditorius*, or ſome other *external* part; but if they then can't hear, you may judge that either the *Tympanum* is broke, or the *Nerve* obſtructed, *&c.*

1. *Attention* conduces to the perfecting a Perception, and you hear a Sound the more plainly, the more attentive you are to it, tho' the *Impreſſion* be always the ſame; becauſe the Soul being only attentive to the Impreſſions of one

Senſe, muſt eaſily perceive the beſt Motion from that part; whereas, if we ſtrive to receive a perfect Perception of many things at once, we are ſo confounded as to receive none perfectly, becauſe ſo many *Refluxes* at once, from different Regions, and to differing parts of the Brain, require ſomething of a more quick Thought than is commonly obſerv'd, for the Soul ſtriving to have a clear *Idea* of each, can't but it ſelf be confounded; and, according to that of a Poet,

Pluribus intentus, minor eſt ad omnia ſenſus.

Whereas, if the Soul has but one thing to mind, it will have a perfect *Idea* of it. An Attention is more peculiarly requiſite in our Senſe of Hearing, becauſe the Soul attending to the *Impreſſions* from this Organ, ſends Spirits into the Muſcle we above mention'd; that from the *Tympanum* reaches to the handle of the *Hammer*, and contracts or ſhortens it; by which the *Tympanum* is more ſtretch'd, and is conſeqnently made fitter for modifying the *Vibrations* of the Air; as the Drum, the more ſtreight the Parchment is extended over it, the greater Sound it makes.

2. They that have loſt their *Auricle*, have their Hearing impair'd, and perceive no more than a murmuring Noiſe; becauſe wanting this part, there is not ſo much of the Air collected and gathered into the *Meatus Auditorius*;

for the Air is not a little help'd on, by the *anfractuous* Windings, and *helices* of this part.

3. We hear better, nigh a River's ſide, or Sea-ſide, the Noſe of Cannons, ſhot of at a diſtance, than otherwiſe, becauſe the *Particles* of the Air reflecting againſt the Surface of the Water, in their *Reflexion* ſtriking obliquely, give their Motion to that Air which comes to your Ear; or elſe we may ſay it proceeds from the particular diſpoſition of the Air over the Water, as being more pure, and not ſo much loaden with thick *Exhalations*; for 'tis certain, that the Earth, and marſhy places on it, affords a much greater quantity of ſuch Vapours, than the River-water, whoſe parts are much more minute, and not ſo intricate; whereas, thoſe that ariſe from the Land are loaden with much Earth, no ſmall quantities of Sulphurs, and more fix'd ſaline Particles, as one may well ſuppoſe.

Laſtly, We judge of the *Site* and *Diſtance*, and other *Qualities* of Sounds, by the ſame Rules we obſerv'd in the Sight.

CHAP. IV.

Of the Voices *of Animals, and* Eccho's.

ALL *Animals* have the Faculty of cauſing a *Sound*, or a trembling *Motion* in the Air, by modifying it, at its Exit from the Lungs, from the difference of which Modifications ariſe all the divers Sounds obſervable in *Animals*; ſo that one *roars*, another *bellows*, another *barks*, and ſo on: But among theſe, only Man has the Trick of ſo *articulating* his Words, and ſo modifying each Breath of Wind, as is neceſſary for the forming an intelligible *Dialect*, or *Language*, and by this way of communicating his Thoughts to others of his Species.

This Voice of *Animals*, is nothing but a *Sound*, and is cauſ'd by the ſame *undulatory* Motion of the Air, with other Sounds; for the Air, by the falling of the Lungs, and contraction of the *Diaphragm*, being expell'd the place it was in, by impelling the external Air, moves it, *&c.* therefore even when we breath, we cauſe ſome ſort of Noiſe, which is increaſed, the greater is the *Expiration*, or *Inſpiration*; ſo that the Air driven out of the Lungs, to make way for its ſelf, muſt force farther on the Air next it, and ſo on; and again, the little Bladders of the Lungs being dilated, the Air forces in, becauſe there is leſs Reſiſtance on that ſide, than in the place it was, as is apparent, ſince it was there depreſs'd by the incumbent *Atmoſphere*: Therefore in this Action, again, a Sound is raiſed, becauſe the Air, again, is vibrated to the Ear.

After this manner therefore, the Air in common *Reſpiration* forms a Sound, we will now proceed a degree farther, and ſee how a lowder Noiſe is caus'd; which we ſhall find, is effected by the Motion of the *Uvula*, and *Epiglottis* againſt the Air, or of the Air againſt them; for when we only breath, we can obſerve no Motion in the top of the *Wind-Pipe*, but when we try to cauſe a greater Sound, we in a manner contract the *Trachra Arteria*, and move on the *Epiglottis*, by which means the Air with force impells the *Uvula*, and againſt its looſe Subſtance receives a more trembling Motion.

Laſtly, there remains, that the Sound be articulated, in which one thing 'tis, that the Air in Speech is more peculiarly modify'd, than in other Sounds: This *Modification* is for the moſt part perform'd by the *Tongue*, tho' anſwer'd by the motion of the Lips, and whole Mouth; ſo that the *Tongue* is ſometimes mov'd upwards, towards the Palate of the Mouth, ſometimes downwards, other times one way, others another, according to the Letters, Syllables, and other Accidents of the Word to be articulated; for ſuch a Motion of the Air, neceſſarily cauſes ſuch a Sound, and ſuch a Sound, ſuch a *Perception*; ſince juſt as the *Motion* of the Tongue, and other parts is adapted (which is according to the Word to be pronounced) ſo is the trembling in the Air: That it would be a good way of teaching Children to ſpeak ſoon plain, by ſhewing 'em the *motions* of the Mouth and Tongue, for the pronouncing each Letter and Syllable; and by this way, People, from their Nativity deaf, have learn'd to ſpeak; and by knowing the *motion* for ſuch Words, to know when they were utter'd.

The other *Diſtinctions* in Voices proceed either from the various Structure of their ſubſervient Parts, for it much conduces whether the Parts be more *lax* or *firm*; and alſo from their particular *Conformation*. Then likewiſe there is a particular Motion of the Parts cauſing Sound, natural to each from their Childhood, from which a *Diverſity* in Voices ariſes; hence alſo an *Affectation*, in many obſervable, alters the Sound; ſome have an affected way of ſpeaking thro' their Noſe, others in their Throat, *&c.* The Voice is higher or lower, the more or leſs ſtrong is the *Contraction* of the *Diaphragm* and *Lungs*; for a violent Expulſion of the Air cauſes a great Motion in it, and conſequently a great Sound, and on the contrary; hence 'tis ſome have a ſtronger Voice than others, becauſe they have a livelier Spring in theſe Parts.

It might be here expected, that ſince I have gone ſo far in reaſoning on the Diverſity of Voices, that I ſhould give a reaſon why young Women and *Eanuch's* have commonly a more fine Voice than others, in which (tho' it be a ſomewhat difficult Undertaking) I ſhall endeavour to ſatisfy the curious *Reader*, whom I hope I ſhall not much diſpleaſe, tho' I undertake more than I can well accompliſh, ſince 'tis ſo very nice a Point, and not attempted (as I ever read) by any Author, and,

——*Novitas gratiſſima rerum.*

it may be, my confus'd Notions of it, may give occaſion to ſome other more fully and more learnedly to diſcuſs it: We muſt then firſt know, that tho' 'tis more common to meet with theſe fine Voices in the Perſons above-mention'd, yet that there are ſome Men (and very common too) whoſe Voices are not much inferiour, and conſequently that there is a particular *Structure* and *Conformation* of the Parts, to us undiſcern'd, that is neceſſary for rendring a Voice perfectly *Melodious*; but we meet with theſe more frequently in *Eunuch's*, becauſe they have moſt commonly a more rare, fine, and ſmooth *Conformation*, of not only theſe Parts inſervient to the *Speech*, but likewiſe of the other Parts of their Body: Now the more ſmooth and fine the Parts are, along which the Air is driven, the more equal will be its *impulſe*, and the more ſtrict is the *Loalition* of the Fibres, the more *acute* will the Sound be, ſince the Air is more ſuddenly, and with greater force expell'd by them; ſo that we may ſuppoſe that 'tis this *Conformation* of Parts which makes their Voices ſo fine; and why it ſhould be more peculiar to theſe, muſt be deduced from the particular *State* of their Humours; for certainly the finer is the *Succus Nutritius*, appos'd for the Nouriſhment of each Part, the finer will be the *Contexture* of the Parts nouriſhed by it; whereas, if it be either too *viſcid*, or *ſaline*, that is, if its *Sulphur* has a more conſiderable Conſiſtence, and contains a great quantity of *acrid* Salts, it disjoins the *Fibres* it is to nouriſh one from the other, and often cauſes a greater *Accretion* in one part of a Fibre than another, according to the *Interſtices* of the Fibres, which in ſome may be too narrow to admit this thick *Lymph*; then again, the *acrid* Salts cauſe often an *Eroſion* of the Parts, or by their ill-tim'd *Fermentation*, an unequal *Diſtribution* of the *Lymph*, as likewiſe a Diſſipation of the moſt thin and volatile Parts. But here, ſince I ſeem here to ſuppoſe the *Succus Nutritius* in *Eunuch's* to be more thin and fine, you may be curious to know how this ſhould happen; I anſwer, That this proceeds from their *Seed*, which not being ſecern'd, wanting its proper Strainer, remains in the Blood, and joins it ſelf with the *Succus Nutritius*, or *Lymph*, of which it before was the moſt thin and rare

Part; for we can think the *Seed* nothing elſe, than the very *Quinteſſence* of the nutritious *Lymph*; and that part of it, which by circulating, and fermenting, is moſt qualify'd for the noble Work it is deſign'd; but now continuing with the *Lymph*, no doubt but it makes it more fine and rare, and conſequently more fit for nouriſhing the Parts of the Body, and for better *Accretion*: And this thinneſs of the nutritious *Lymph*, is doubtleſs the cauſe that young People, Women and Children, have a more neat and fine *Conformation* of Parts, for their Blood not undergoing ſo great a loſs of its volatile Parts, as in Men, by reaſon of the præternatural *Fermentations* it does, no doubt but the *Succus Nutritius* will be more fluid: Hence likewiſe 'tis, that Children of the common ſort, by reaſon of their violent Motions, raiſing immoderate *Ferments*, are of a more rough and courſe *Nature*, but yet they have ſomething of it from their Parents, whoſe *Seed* is ordinarily more *viſcid* than that of your better Qualities is, as being inur'd to harder Labours, by which the Blood is render'd more *viſcid*, as loſing by *Evaporation* its volatile Parts; neither does this deſtroy their Strength, which we ſee they have more of than thoſe that do labour, ſince the more craſs *Sulphurs* are fitteſt for the greateſt *Motions*, and are not ſo ſoon diſſipated as the leſs; hence Labourers are not ſo ſoon weary'd.

It may be thought that I have been too long upon an unneceſſary Point, and yet I can't paſs by one Obſervation; that is, in Colds, one is ſubject to Hoarſneſs, and always (if they be in the Mouth and Lungs) loſes the ſweetneſs of the Voice, which one may ſuppoſe to proceed from the ſame *viſcid Lymph*, which produceth the Cold, by ſticking in the Fibres of the Parts, and making 'em lax, unequal, and rough; and this I imagine does not a little confirm my Opinion, as by conſidering you will find. I might here proceed much farther, but not to tire the Reader, I will conclude.

A Man ſpeaking thro' a *Speaking-Trumpet*, can be hear'd farther than otherwiſe, becauſe of the *Repetite Vibrations* the Air receives in this Cavity, by which it is ſent forward with greater force, than without it; ſince from your Mouth the Air immediately has a whole *Atmoſphere* to move, to make way for its ſelf, and therefore is much ſpread and diſſipated; whereas, the Sound from the Trumpet is collected into a round Ball in a manner, and therefore paſſes with greater force.

Laſtly, an *Eccho* is form'd by the Reflection of the vibrated Air, meeting a ſmooth, and ſolid Body; for the Air, as well as other *Mediums*, muſt glance from Objects it can't paſs by, and ſo change its firſt *Determination*, and be reflected accordingly, as the Object is ſituated; ſo that if the Object be ſituated, againſt the place the Sound proceeded from, the Sound will be twice heard in that place; ſince the Sound, being carry'd from the Center to the Circumference, the *Trepidations* of the Air, meeting the ſolid Body, muſt be ſent back, obſerving the Rules of Reflection; ſo that if the Object ſtands oppoſite to the mov'd Air, it will be reflected again to the Center, *&c.* If the Object ſtands ſide-ways, the *Eccho* will not be again heard in the place it was firſt form'd, becauſe the Air will receive a ſide Reflection, and ſo run on another way. If the *Circular Undulations* of the Air in different places and diſtances, occur with Bodies ſolid and impenetrable, the ſame Sound will be often rebounded, according to the Number and Site of the Objects: So that you may ſometimes, and in ſome places, hear a Word doubly, tribly, *&c. eccho'd,* and one *Eccho* before another, as coming from a place not ſo remote, the Object's reflecting 'em being one farther, and another nigher the place the Sound proceeded from.

The reaſon why we hear but the latter part of the Sound *eccho'd*, is becauſe the Air mov'd by the firſt part of the Sound, and arriving firſt at the *ſolid* Body, is firſt reflected; ſo that in its Reflection, it muſt meet with the Air mov'd by the latter part of the Sound, and conſequently to it communicates its Motion, not being able to conquer it force; by which means the *Eccho* of the end of the

Word or Sound, is as loud, ſometimes louder than when firſt form'd, becauſe it hath a double force, to wit, its own, and likewiſe that with which it was repell'd by the fore-running Circles.

A TREATISE OF SMELLING.

CHAP. I.

Of the Organ.

THE Organ of Smell may be divided likewiſe into external, and internal Parts; the external are eaſily ſeen, and are diſtinguiſh'd into Superiour, that is, the bony part next the Eyes, or *Dorſum Naſi*; and Inferiour, *Cartilagineous*, and *Mobile*; its extremity is call'd *Globulus*, its lateral parts *Pinnæ*, or *Alæ*; the *Septum* ſeparates the Noſe into the Noſtrils, which Separation is not a little uſeful, in order for preventing *Suffocation*, for one of the Noſtrils is often ſo obſtructed with viſcid Matter, as to hinder the Paſſage of the Air.

~~The inſide of the Noſtrils~~ is lin'd with a Membrane, furniſh'd with certain Glands, whereby a viſcid Matter is ſecern'd from the *Maſs* of Blood: For induſtrious Nature takes care to diſcharge our Body of all manner of Humours, which, if remaining in, and circulating with the Blood, might cauſe either a too great *depreſſion* of its Particles, by entangling the fermentative *Principles*, or volatile *Salts*; or elſe too great an *exaltation* of the *Principles*, and that way a too great *fermentation*, from whence a *diſſipation*, and then viſcidity and thickneſs of the Blood; both which to avoid, ~~and all other Inconveniencies which~~ may be induced by fix'd Salts, as *Coagulations* by *Acids*, *Diſſolutions* by *Alkalines*, there are placed in different parts of the Body many *excretory* Veſſels, for to ſeparate ſuch Humours as are no longer able to afford any nouriſhing parts, or otherwiſe uſeful: The *Kidnies* are adapted for the Reception of the *Lotium*, or Urine, whoſe Glands are of a magnitude and figure fit only for the Deſcent of this Humour, by which the Blood is purg'd of a volatile *Alkaline* Salt, and unneceſſary *Phlegm*: The Glands of the Skin are not much unlike thoſe of the *Kidnies*, and ſeparate a Liquor much the ſame; ſo that when much is evacuated by Sweat, the Urine is in quantity leſſened, and on the contrary.

The Glands likewiſe of the Ears and Noſe drain of a viſcid Matter, fitted for the Preſervation of thoſe Parts, by which alſo the Blood is diſcharg'd of a *glutinous* Subſtance, of no farther uſe in the Body.

The chief Organ of Smell is certain fine *Membranes*, back'd with ſome thin Bones, thro' which the Fibres of the *olfactory* Nerve are diſperſed, forming little Tufts on the Membranes, on which the thin *odoriferous* Particles lighting, agitate 'em according to their Bulk, Figure, and Motion.

The *olfactory* Pair is the firſt that appears in diſſecting the Brain, call'd at its riſe *Proceſſus Mamillaris*; tho' it takes its Origin from the *Corpora Striata*, from whence proceeding, it paſſes thro' holes of the *Os Cribroſum*, &c.

The Motion of the Noſe is very inconſpicuous; it is enlarg'd by certain *Muſcles* from thoſe of the Cheek, placed from it; in is contracted by others placed in it; it has Arteries from the *Carotides*, Veins from the external *Jugulars*.

The particular Accidents of the Noſe, are *Inflamations* and *Ulcers*, often produced by the *acrid* Humours paſſing this way, in inveterate Colds: *Excreſcencies*, as the *Polypus* and *Sarcoma*, from an Obſtruction by the nutritious Lymph: *Hæmorrhagies*, from the *Acrimony* of the Humours, or *Plethora*, by which the Veſſels on the inſide of the Noſe are eroded, or broke.

CHAP. II.

Of the Object of Smell, viz. *Odorous.*

AN Odour is a Faculty in odorous Bodies, by which they affect our Organ of Smell, borrow'd from the particular Structure, and other Qualities of their Parts, and therefore not rightly underſtood by thoſe, who defin'd it, *A Mixture of Hot and Cold, Dry and Humid*; ſince this *Definition* is not only proper to Odours, but Taſtes, *&c.* all which are a Mixture of theſe *Temperatures*; ſo that the Antients had better with us have defin'd Odours by its Qualities, and omitted that general Definition, for a particular Power; then by muſtering up an undeterminable Mixture of its component Particles, to omit, as they have done, the real Qualities, that render Bodies *odorous*, and without which they can't be ſaid odoriferous, more than ſapid, ſonorous, *&c.* Therefore they doubtleſs have been more Circumſpect and Cautious, who conſidering that Odours affect by the particular *Motion*, *Magnitude*, and *Figure* of their Parts, have deſcrib'd this peculiar Faculty of odorous Bodies by the Motion, Magnitude, and Figure of their Particles, from which they have the power of moving the *olfactory* Nerves, and exciting a *Smell*.

Odour is the only Object of our Smell, and is an *Exhalation* proceeding from more *ſulphureous* Bodies, diffus'd thro', and mix'd with the Air, by which it is convey'd to the Noſe, where the Organ of Smell is placed; and there, according to its greater Rigidity, Looſneſs, Magnitude, or its oppoſite, greater, or leſs Motion, and particular Figure, (all which Qualities they are endew'd with, as the Bodies from whence they are exhaled, have more or leſs *Heat*, *Cold*, *Siccity*, or *Humidity*; by which they are fitted for concocting, or hardning, diſſolving or looſning, increaſing or leſſening, exalting or depreſſing the Particles to be ſeparated) they ſtrike with greater or leſs force on our Organ, cauſe a ſtronger or weaker *Impreſſion*, from which difference ariſes the diverſe Smells obſervable.

Odorous Bodies, by a moderate Heat, emit a more ſenſible Odour; and on the contrary, when very Cold, they leaſt affect our Organ; becauſe by Heat, the Bodies are ſet a *fermenting*, by which means the *Series* of the concurring Particles is interrupted, and the *Materia Ætherea* therefore ſhut up in the Pores; which breaking looſe, carries the moſt volatile Parts with it, and thoſe that lay in its way; ſecondly, the Particles likewiſe of the mix'd Bodies by Motion, as when hot (for all Heat comes from an *intrinſick* Motion of the Parts) are leſſen'd; and by Fermentation, the moſt fix'd Parts *volataliz'd*, and ſo there is a greater quantity of Particles render'd exhalable, and diſengaged from the reſt of the Heap; which the more was their Motion when join'd with the other Parts (and that is to be judg'd from the greater or leſs Heat of the Bodies) the more force they will have when they ſtrike on our Organ, and the *Impreſſion* will be more lively; whereas, *odorous* Bodies, the more cold they are, the leſs they ſmell, becauſe the Particles then reſting give free Paſſage to the *Materia Subtilis*, ſo that few or none ariſe from them, and therefore have no ſmell, unleſs cloſely apply'd to the Noſe.

Herbs and Flowers, by being rubb'd, are rendred *odoriferous*, if not ſo before; and *odorous* Subſtances, thus handled, will have a more ſenſible ſmell, and this for the Reaſon above cited; for being rubb'd, the Series of their Pores are interrupted, and therefore the *Materia Æthera* is made Priſoner, which being always in a violent and rapid Motion, breaks thro' and drives the obſtruent Particles before it, which mingled with the Air, are brought to the Noſe, and fix on the little Tufts, form'd by the Fibres of the *olfactory* Nerve: Thus Iron, Stones, and other hard Subſtances, emit an Odour; and from the Motion of the ſubtile Matter in their Pores, 'tis that they fly to pieces, if ſtruck with force againſt Bodies of the ſame ſtrength; for by the ſhock given 'em, their Pores are interrupted, the *Series* of their Particles being likewiſe loſt, as any one may conceive; the ſubtile Matter (of which all Places and Bodies are full) is incarcerated, and ſhut up in a place more narrow than before it was contain'd in, and therefore by ſtriving for a larger Room, it ſeparates the *Contexture* of the Bodies, and *Connexion* of its Particles, with more or leſs eaſe, the leſs ſtrict is their *Connexion*; ſo that ſome Bodies being of a looſe coherence are eaſily broke to pieces, as Glaſs, *&c.* ſome as more ſolid and cloſer knit together, will bear a great ſhock without being much endamaged, as Stones, *&c.* But of all Bodies, *Metalline* are the hardeſt to be broke, becauſe their Connexion is much more ſtrict, and they abound with much *Sulphur*, which is the beſt Ligament to bind faſt the Parts of any Bodies. We meet with ſome Subſtances that quickly loſe their Odour, and in ſome time again acquire it, eſpecially if heated or broke; firſt, after ſome time they loſe their Smell, becauſe all the Parts that were ſufficiently diffracted to riſe in *Exhalations*, are diſſipated; ſecondly, they again acquire their Smell by heating, becauſe by Motion other Parts are leſſened and made fit for an *Impreſſion* on this Organ; ſo that ſome Bodies are no longer odorous than when agitated or rubb'd, for the Reaſon above cited.

Now tho' all Smells come from the *Exhalations* of Bodies, yet there are Exhalations that have no Smell, and are either too minute, or of an unfit Figure for moving the *olfactory*

Nerves: Such are the Vapours, Water is reſolv'd into, whoſe *Particles* are judg'd to be Oval, from the many Obſervations drawn from its Effects; a Figure, as any one will find unfit for *irritating* any part, the ſame of the *globular* Figure; ſo that it was not *gratis* that we placed part of the *Eſſence* of Odours in the Figure of their Particles, and from the *Motion* (from which how much Odours borrow is amply already conſidered.) Figure (here likewiſe prov'd neceſſary to the forming a Smell) and laſtly, *Magnitude* by which all Bodies whoſe Particles are extream ſmall, are excluded from giving an Odour; of this Claſs are the airy *Particles*, which of themſelves are not endow'd with any Smell, but when loaded with many *heterogeneous* Parts, and *volatile* Vapours ariſing from other Bodies that are odorous: From which three Qualities may be drawn the whole *Rationale* of Effects proceeding from odorous Bodies.

Laſtly, That theſe three *Qualities* deſerve the firſt Rank in the Conſideration of Odours, will be perceiv'd, if we only caſt an Eye on the great diverſity of Smells, (for there are almoſt as many different Smells as different Bodies, from whence they proceed) for how could we conceive that one Body ſhould cauſe one ſort of Impreſſion, another another; one ſtrike more ſtrongly than another, without recurring to the *Motion* they give the Fibres, which can be no other than they themſelves have, for nothing can give what it has not; to the *Figure* by which they are fitted for a more or leſs lively *punction*, grating, *&c.* of the *Fibres* they meet with, to the *Magnitude* by which they produce a greater or leſs *Irritation*; for great and little Bodies can't affect after the ſame manner. Therefore if the *Motion*, *Figure* and *Magnitude*, of the Odour, are all adapted for a moderate Impreſſion in the *Fibres*; the Smell of ſuch a Body will be thought grateful; ſo that according to to the various degrees of *Fermentation* in mix'd Bodies, the more or leſs grateful will the Odour be; for by a moderate *Fermentation*, the parts of the fermenting Body are moderately *diffracted*, and have a moderate Motion, and nothing of that *bizarre Figure* they had before this Action, that then the Smell from them reſulting muſt be pleaſing: Hence even fœtid Bodies, after ſome time fermenting, have been obſerv'd to emit a grateful Odour. All violent Impreſſions of the *Fibres* cauſe ungrateful Smells, becauſe they riſe a too violent reflux of the Spirits; therefore, if the Parts making the Odour are more rigid and bulky, the greater Motion they cauſe in the *Fibres*, and the more ungrateful Senſation; and thoſe ſorts of *Exhalations* moſt ordinarily proceed from Bodies that have undergone immoderate *Fermentations*, by which all the moſt *volatile* Parts being diſſipated, and none but the more ſluggiſh and fix'd remaining, *i. e.* fix'd *Sulphurs* and *Salts*, that cannot ſo place themſelves, as not to fill up continually the *Interſtices*,

terſtices, and cloſe on the *ſubtile Matter*, which breaking forth, drives a greater quantity of theſe *Particles* before it, and diſperſes 'em in the Air; and hence 'tis that theſe filthy Smells commonly can be perceiv'd farther than others. The *Particles* therefore cauſing grateful Smells, or *Perfumes*, are Salts, or *Salts* with *Sulphurs*, of a more thin and fine *Structure*; and thoſe cauſing ungrateful Smells are of a Structure more unhew'n, large and rough; yet the fineneſs of the *Organ* often much conduces to the perception of a grateful or ungrateful Smell; for even thoſe Odours which to me are *Perfumes*, to others are odious Smells; becauſe their *Organ* being of a more nice perception, thoſe *Particles* which but produce a gentle motion in the *Fibres* of my Noſe; in theirs, the coat of their *Fibres* being thinner, cauſe a violent Impreſſion, and ungrateful Perception. Again, by this *diverſe Conformation* of the *Organ*, of this Senſe *Brutes* know, what as being to them of a grateful Smell will preſerve them, and ſatisfy their Hunger, and what as ungrateful to avoid; by that means refraining thoſe things which might hurt 'em if receiv'd; hence thoſe of one *Species* ſeek one thing, *&c.* *Cats* ſeek *Calamint* by its Odour; *Serpents* ſeek *Fennel*, *&c.* And for the ſame Reaſon *Scorpions* abhor *Aconite*, *Serpents* the ſmell of *Galbanum*, &c. And whence could this wonderful *Sympathy* and *Antipathy* of *Animals*, in this reſpect, proceed, if not from the various *Formation* of the parts of the Noſe? For if this part be made up of fine and thin *Fibres*, which in great Number lie here expanded, the moſt moderate Odours will be the moſt grateful, ſince either a gentle or rough *Impreſſion* of Odours cauſe in one a too weak Reflux to cauſe any great Titillation, in t'other a too violent one, and conſequently too great a Motion in the Parts of the Brain; if this Part have *Fibres*, both thick and hard, few Scents will ſeem *fœtid*, becauſe few Vapours will have Parts ſo large as to cauſe too great a Motion in theſe ſtiff *Fibres*; the ſame if the *Fibres* are any ways *relax'd*, as by the too great *ſeparation* of *Seroſities*: So thoſe Odours which at firſt were thought *fœtid*, may in time (the Organ by many Irritations being hardened and indurated) be better tollerated, and even ſome times ſeem pleaſant, as we find verify'd in thoſe who accuſtom themſelves to rich Perfumes, and after ſome uſe ſcarce perceive any Scent in them. Thus Cooks, that are daily fed with the rich Fumes of the Meats, loſe by inſenſible degrees the Purity of their Smell, that they only have a moderate *Perception* from Odours, others can't tollerate. *Dogs* have the greateſt *Perfection* in this Senſe, and can diſtinguiſh by it the difference even of our inſenſible *Tranſpirations*, and by it follow his Maſter, tho' three or four Miles before him; and this one would think proceeds from the fineneſs of the *Fibres* of the Noſe, which are extream thin and ſmall, fitted for the *Reception* and *Impreſſion* of the moſt minute Particles. I ſhall not here give a Reaſon, as ſome do, why Man has not ſo great a *Sagacity* as other Creatures, nor ſay that it proceeds from the thick Vapours he has always, and does accuſtom himſelf to; by which his Fibres are hardned, to which, tho' ſomething may be allowed, yet I don't believe that ſuch extream Perfections of the Senſes was ever deſign'd for Man; neither ought we to compare our ſelves with ſenſitive Animals only, leſt we ſo neglect the great End of our Creation; but rather we ought rationally to converſe with God, by admiring his Works, and feed our Souls before our Senſes; and not deſire that Perfection in them, and grudge other Creatures the only thing they have whereby to preſerve their Exiſtence.

To conclude, I think the Nature of Odours to conſiſt in certain volatile Salts, by *oleous* and *ſulphureous* Parts modify'd for a gentle *Perception*, for we find thoſe Bodies always moſt odorous which moſt abound with theſe *Principles*; nay, I may add that all *odorous* Bodies, according to the Quantity, and Nature of theſe Salts, the more or leſs grateful or ungrateful they are; and certainly, the more a Body abounds with Sulphurs, Acids, Salſe, or acrid Salts, the farther you'll perceive it, and the more ſtrong will its *Perception* be. If a Body be moſt ſtored with Acrids, and theſe extricate, it can have no grateful Smell, becauſe theſe Salts by turning round their *Center*, excite a

Senſe of *Corroſion*, and an unequal Reflux of the Spirits; if they be wrapped up in *Sulphurs*, the *Perception* and *Odour* may be grateful, becauſe then they can't cauſe ſo deep an *Impreſſion*, but rather a gentle *Titillation*: Salſe, and Acrids likewiſe by the ſame means are render'd fit for a pleaſant or ungrateful *Perception*; tho' *Salſe* are commonly ungrateful, becauſe of their bulk: In fine, I am more induced to the maintaining this Opinion, becauſe I have found that theſe are the only parts fitteſt for the receiving, continuing, and communicating Motion, as any one by *ruminating* on their Effects will likewiſe find.

CHAP. III.

Of the Nature, &c. *of* Effluviums.

ALL manner of *Exhalations*, from what Bodies ſoever they proceed, are likely the moſt volatile Parts of the Mixture, inviſible, and as *Attomiſts* will have, indiviſible; tho' *Carteſius* and his Followers maintain, That all Matter is *indefinitely* diviſible; but to determine this, is, beſides my preſent Undertaking, ſince all I have to do, is to derive the Exiſtence of *Effluviums*, and laſtly, to conſider their Nature and Riſe.

And firſt, the Exiſtence of *Effluviums*, I imagine no one will deny me; or if any are ſo diffident and faithleſs, I ſhall refer them to Mr. *Boyle*'s Book, where it is more amply diſcus'd; or elſe he may convince himſelf with a ſmall quantity of *Camphire*, which kept for ſome time in exact Scales, will by degrees loſe its weight, which can proceed from nothing elſe but the continual Evaporations of its Parts; the ſame is to be experienced in other Bodies whoſe Smell is conſiderable, tho' others who have this Quality more imperfect, will not by ſo ſmall a loſs of ſuch extreamly minute *Atoms* loſe any ſenſible weight.

The Qualities of theſe *Effluviums* are perfectly handled by Mr. *Boyle* in the ſame Book. And Firſt, Their *Subtility*, to which I ſhall add nothing. Secondly, Their *Penetrating Nature*, which any one may experience, by corking up in a Glaſs-Bottle your *Sal Volatile Viperinum*, a great quantity of which, in a few days, will be flown, without leaving any marks in the place they paſs'd. If you put your *acid* Spirit of *Vitriol* into an earthen Veſſel, in ſome time you'll find the Veſſel brought into fine Powder, and your Spirit gone: Other *Experiments*, for the Confirmation of this Quality, I could here produce, which for Brevity's ſake I omit. Another Quality of *Effluviums*, is, their rapid Motion, whoſe Effects are to be ſeen in the *Aurum Fulminans, Gun-Powder*, and *Flames*; for a Flame is nothing but theſe *Effluviums*, which by their violent and continual Motion, riſing from the Fuel, cauſes ſuch a Motion in the *Materia Ætherea*, as to make it ſeem white, and æmulate the Sun, by affording us a Light whereby to compleat our Buſineſs when the Sun is retired, and skreen'd from us, by the Interpoſition of our Globe. All which Qualities of this Matter, if we rightly conſider, we ſhall find they come the nigheſt of any thing to the Nature of *Carteſius*'s Second Element, or *Subtile Matter*.

By theſe *Qualities* we are brought to a Knowledge of the Particles compounding theſe *Effluviums*, for certainly nothing but what is moſt minute and *volatile* is capable of producing ſuch *ſtupendious* Effects; Yet we can't but imagin a diverſe Nature even in *Effluviums*, according to that of the Bodies they proceed from, which is compounded of moſt *alkaline* Salts; the *Effluviums* will be moſtly of this Nature, and extream Penetrating, and be fitter for more or leſs Motion, as they participate more or leſs of the true Nature of an *Acrid*. If the Mixture be moſtly *Acid*, theſe will be likewiſe *Acid*, &c. If the Salts of the Mixture be more fix'd, theſe will be ſo likewiſe; if thoſe are more *volatile* and penetrating, theſe will have the ſame Qualities, but in a much higher degree. In fine, by knowing the Salts the mix'd Bodies abound with, we know likewiſe thoſe of the *Effluviums* ariſing from them, ſince theſe are but the moſt diffracted and extricate Parts of them, which by *Fermentation* have been leſſened and ſeparated from the other Parts of the Body, by which they were depreſſed. Thus, an Odour is nothing but an *Effluvium*, which diſpers'd with the Air, with it gets into the Noſe, and there cauſes a Smell.

Laſtly, The *Separation* of theſe *Effluviums*, from the mix'd Body, is perform'd by the *Intermediation* of the *Subtile Matter*, which being every where diſpers'd, and penetrating the moſt intricate Pores of Bodies by its vehement Motion, is the cauſe of all Motion in other Bodies; *Fermentations* depend on it, and are only produced by Particles, which with their Points, ſtop up the Pores of each other, and therefore lock in (as one may ſay) the *Æthereal Matter*, which ruſhing forth cauſes this Motion, and in the mixture of Spirits often a perfect *Ebullition*; by which *Agitation* the Saline Parts muſt neceſſarily be leſſen'd, ſo that we find fix'd Salts, by *Fermentation*, to become volatile, and theſe volatile Parts by the ſame Motion are ſegregated from the *Mixture.* and become *Exhalations.* Hence all ſulphureous Bodies are generally obſerv'd to be moſt odorous, becauſe moſt intricating; ſo that without the help of theſe no *Fermentations* could be produced. In fine, the hotter Bodies, the more *Effluviums* they emit, becauſe the Motion is much more conſiderable, and by it the ſtreight *Series* of the Pores is interrupted, as faſt as broke again open by the *Subtile Matter*; therefore we ſee Liquors often all evaporated by the Fire.

CHAP. IV.

Of the Perception of Odours.

SMELLING in Men may be ſaid the moſt unneceſſary of the Senſes, and one the beſt might be diſpenſed with, not that it is conſidered by it ſelf unneceſſary; for certainly there is not that diminutive part of the whole Creation ſupervacaneous, but only *reſpectively*, as being the moſt imperfect, and the Inlet of more nauſeous and fœtid, or diſagreeable Qualities than the others. In other *Animals* we may think it more neceſſary, ſince it is the beſt Guide to 'em in the ſearch each hath of his proper Suſtenance; by this they are conducted to the choice of thoſe *Aliments*, which will, by nouriſhing the Parts, preſerve their Fabrick; and the declenſion of others, which by raiſing immoderate *Fermentations*, might rather hinder than promote Nutrition. But Man in this is better inſtructed by his Reaſon, not but that I think our Senſes neceſſary to our *Preſervation*; but that therefore it was not ſo neceſſary they ſhould in Man be ſo perfect as in other Creatures; *Vt ſuperiorum cultui & execritio relinquerets locus.* Willis.

Some have placed the Organ of this Senſe in the *Proceſſus Mamillares*, which can't be, ſince we find no Paſſage for the *Exhalations*

of

or Odours to paſs, unleſs they mean there to place the Organ of Senſation where the Soul perceives the Impreſſions from our outward Senſes: But I ſhall rather confine this *Organ*, with others that have writ on this Subject, to the thin *Fibres* of the firſt Pair expanded, as above ſhewn, along the *Baſis* of the Noſe, and there forming a thin *Papillary* Membrane, moſt fit for the receiving an Impreſſion from the ſubtile Vapours of odorous Bodies. This Opinion is made more evident, by the Soul's referring all our *Perceptions* of Odours to this Part, and alſo by the Impreſſion and *Titillation* we here feel at the preſence of odorous Bodies; which *Impreſſions* by the refluent Spirits, are convey'd to the Brain.

Some have imagin'd *Reſpiration* neceſſary for the Perception of Odours, which, tho' deſign'd likewiſe for more noble uſes, is not at all unlikely; ſince the Air, by the *Expanſion* of the *Veſiculæ Bronchialis* is forced in with an Impetuoſity by the Preſſion of the *Atmoſphere*, and with the *volant* Vapours, which by this Motion ſtrike more forcibly on the Fibres; and as an Odour is better, and farther perceived when carry'd by a brisk Breeſe, the ſame likewiſe happeneth in our Inſpiration, which the ſtronger it is, the more force it gives the odorous Particles, *&c.* For this Reaſon grateful Perfumes, if the *Inſpiration* be very ſtrong, are render'd ungrateful, by the vehement Motion the Particles thus agitated communicate to the Fibres, and theſe by the undulation of the Spirits to the Brain, not unlike that of the thicker and *fœtid* Odours: Therefore the *Perception* of odoriferous *Subſtances* is moſt perfect, when the Inſpiration is only moderate, for then their Motion is moſt natural; ſo that Inſpiration is ſo far an help in this *Senſation*, as it gives more force to the odorous Particles; and *Expiration* on the contrary is as great an hindrance, the Odours by it being expell'd.

When any Cold or ſerous *Rheum* falls on the inſide of our Noſe, and theſe *Membranes* whoſe Action is neceſſary in this Senſation; becauſe by it the Action of the odorous Principles is broke, and they in a manner diſſolv'd, therefore it is neceſſary that our Noſe be clear from all ſuch Matter, for us to ſmell any thing perfectly: And hence thoſe whoſe Organ is only moderately water'd ſmell the beſt, and a moderated watering conduces to the preſervation of the Membranes in a due Temperature.

A
TREATISE
OF
TASTE.

CHAP. I.

Of the Taſte.

THE *Tongue* is the principal Organ by which we perceive the Taſtes of Bodies; it is ſeated in the Mouth, the place by which all our Aliments are to paſs to our *Stomach*; its Subſtance is fleſhy and fungous, inſtructed with an innumerous Company of Fibres, which, as *Malphigius* has accurately deſcrib'd from certain *Papillæ*, or nervous Tufts on the Tongue, which being mov'd by the appoſition of ſapid Bodies, cauſe a *Perciption* in the Soul: The inveſtient Membrane of this part, is extream thin and porous, for the better admitting the Particles of ſapid Bodies. 'Twill be uſeleſs to deſcribe the Figure of the Tongue, to all ſo well known; its Situation is ſo contriv'd, that it ſerves at once for two no leſs neceſſary *Operations*, the Speech and Taſte; its Seat therefore, as I ſaid, is in the Mouth, under the *Palate*, faſtned to the *Larynx*, or top of the Windpipe, and *Os Hyoides per Syſarcoſim*, i. e. by the fleſhy Fibres, likewiſe to the bottom of the Mouth and *Tonſillæ*; and is by a valid and membranous *Ligament*, firmly connected underneath; and this *Ligament*, towards the tip of the Tongue, is call'd *Frænum*, or Bridle, becauſe it bridles the Tongue, and keeps it within its limitted Bounds.

'Twould be uſeleſs to make a particular Enumeration of all the parts belonging to the Mouth, wherefore I ſhall content my ſelf with thoſe that have the greateſt Appertinence to this Organ, as are the *Roof* of the Mouth, and all the inmoſt Lining, which, like the Tongue, are endued with theſe *Papillæ*, which render 'em capable of receiving an Impreſſion from ſapid Bodies. The *Roof* of the Mouth is ſomewhat concave, and form'd in a vaulted manner, its Subſtance *fibrous* and *glandulous*, by which is the *Salivi*, or Spittle ſecern'd, and convey'd into the Mouth, which is ſurrounded with theſe *Glands* on all ſides. But now for a more particular Deſcription of the Tongue,

Which is, as is ſaid, a ſoft, rare, and ſpongious Subſtance, continually moiſtened with the *Saliva* from all Quarters of the Mouth, which ſerves for to diſſolve the *Aliments*, ſo as to diſengage thoſe parts, which by irritating the nervous Tufts of the Tongue, are fit to excite a *Perception:* From the too great *Viſcidity* of this watry Humour, 'tis, that we often become dry, becauſe then it cauſes continual *Impreſſions* in the Fibres of the Mouth, and conſequently a moleſt *Senſation:* This happens after violent Exerciſes, in *malign* Fevers, *&c.* becauſe in theſe Caſes the Blood being in a violent *ferment*, great quantities of diffracted Salts tranſpire, and particularly by the Lungs, from whence, with the Air, they are removed into the Mouth, and there remaining with the *Saliva*, raiſe a *Fermentation*, by which the watry part of this *ferment* is evaporated, and the Salts in a manner *chryſtalliz'd*, remaining almoſt *ſiccâ formâ*, moſt proper for irritating the Fibres, and cauſing a troubleſome Senſation in all the neighbouring parts, by the continual *Refluxes* of the Spirits; by which we are induced to a deſire of ſomething *liquid*, becauſe by tryal we have found, that it diluting theſe Salts, does remove this troubleſome Pain.

The Tongue is cover'd with three *Membranes*, the outmoſt of which is hard, and in ſome Animals rough, as in *Lyons*, *Cats*, &c. whoſe Tongue is full of little Hooks, reſembling a *Cat's* Claw. The ſecond *Tunicle* is *Reticular*, made of croſſing Fibres, which like Nets leave holes between 'em, for the paſſage of the *Tufts* of the undermoſt Membrane, whoſe Fibres riſing up one againſt another, form little *Prominencies*, which is alſo obſerv'd all along the Surface of our Bodies, for the framing the Organ of *Touch*, of which this may be thought a *Species*, according to Doctor *Willis*, *Guſtatus ſenſui tactus adeo ſimilis exiſtit, ut iſtius quedam Species eſſe videatur.* The middle part of the Tongue is but a *Series of fleſhy and nervous Fibres rank'd in order by each other*, and forming a Muſcle moſt conſpicuous for its *Motion*, and admirable for its *Agility*, in which it exceeds all the other Muſcles of our Body; its component *Fibres*, are ſome drawn lengthways, and by their Contraction ſerve to ſhorten the Tongue; others are circular, and ſurround the former, ſerving by their Contraction to lengthen the Tongue, by leſſening it in Circumference; as the former, by encreaſing its thickneſs, take from its length.

As for the *Nerves*, from which the Fibres of the Tongue are derived, and wherewith they are interlaced, they ſeem to riſe from a triple Pair, *i. e.* the Fifth, or *Par Maſticatorum*, which inſerves for the Work of *Maſtication*; the Seventh call'd the *Par Vocatorium*, which tho' for the moſt part belonging to the

Lungs, ſends ſome Twigs to this Membrane; laſtly, the Ninth Pair, or *Linquæ Motorium*, makes up the greateſt part of the Tongue, for from it the muſcular Fibres are deriv'd; it hath *Veins* from the *Jugulars*, which are viſible under the Tongue, and *Arteries* from the *Carotides*.

CHAP. II.

Of the Object of our Taſte.

SAPIDITY is a Quality peculiar to thoſe Bodies, whoſe Particles are endew'd with certain Points, by which they are fitted for an *Irritation*, or *Impreſſion* of the *Papillæ* of the Tongue, and cauſing the Perception we receive, from the Application of any of them to our Organ; on the contrary, thoſe Bodies are *inſipid*, whoſe Parts are not of this figure, but either oval or globular, as the Particles of Water, which cauſe no other Perception, than of ſimple Touch, or obtuſely Angulus, as *Caput Mortuums.*

The word Taſte may be underſtood, either for the Senſation it ſelf, which we have when we apply a ſapid Body to our Organ, or elſe for a *Power proper to ſuch Bodies* of moving our Organ, in which ſenſe it is here to be underſtood, and it is a *Propriety* of ſome certain Bodies, whoſe Particles are adapted for ſuch or ſuch a Motion of our Organ: So that a Taſte is but a Motion caus'd in the *Papillæ* of the Tongue, by the Application of a ſapid Body, and by the Spirits carry'd to the Brain. Hence, as I ſaid, thoſe Bodies are inſipid, whoſe Particles cannot thus move the Fibres of the *Tongue*, and are either too minute, as thoſe of Air and

Water are, or elſe are too cloſely combin'd, as thoſe of *metalline* Subſtances, which though abounding with all ſorts of Salts, as other Bodies do, yet they are by the *terreous* part ſo well digeſted, as that not any of 'em are capable of getting ſufficiently at liberty to move the Fibres of the part they touch.

From hence we may gather, that 'tis from their particular *Figure*, *Magnitude*, and *Motion*, that ſapid Bodies have this *Propriety*. From the figure of the component Particles, as above, 'tis, that they can move after ſuch a manner the *nervous* Tufts of the Tongue; ſecondly, 'tis required they have a peculiar magnitude likewiſe, becauſe if too minute, their motion is too inconſiderable to raiſe a Reflux in the Spirits contain'd in the Fibres of the part; if too bulky, they are not capable of inſinuating themſelves ſufficiently into the holes of the upper *Tunicles* of the Tongue, and therefore but induce a *Species* of *Tactus Simplicis*. For the modifying (as to this Quality) of ſapid Bodies, we are inſtructed with Spittle, which muſt not be look'd on a meer *excrementitious* Humour, ſince it has a double uſe; firſt, it contributes to the Taſte, by diminiſhing and extricating the Salts of the received *Aliments*; ſecondly, it is a help likewiſe to the *ſtomatick* Ferment, and therefore ought to be ſwallow'd, not caſt forth; and laſtly, a motion of the parts of ſapid Bodies is neceſſary for producing a Taſte, as well as all the other Effects we daily contemplate: Animals are nothing without it; Vegitables muſt own it the *productive* Cauſe, *&c.* the World without it muſt ſtill have remain'd a *Chaos*, a heap of indiſtinguiſhable Rubbiſh.

We might here conſider the manner of *Accretion* in Animals, how the *lymphatick* parts of the Blood being ſeparated in the Pores of the parts, cauſe an encreaſe, by their continual motion, and *rarefaction* dilating them, and making room for greater and greater quantities of *nutritive* Juice; how the *Accretion* of ſome Animals is ſooner perform'd than of others. I might likewiſe make an Excurſion into the *Vegitable* Kingdom, and there conſider the *nutritious* Juice in each Interſtice of the *ligneous* Fibre of a Tree, Plant, *&c.* at work, and in a perpetual motion, by it dilating *ſenſim ſine ſenſu* the Pores, by that means giving occaſion to a greater quantity of Nouriſhment of entring the ſame *Cabinet*, and by joyning with it to farther its begun *Accretion*: I might here contemplate the different growth of each Plant, and give a Reaſon for the more ſpeedy Perfection of one than another; know whether it is from a greater motion in the *nutritious* Juice of one than the other; whether the motion of this Liquor, the livelier it is, will faſter dilate the Fibres of the parts, and ſooner bring 'em to their *final* ſtretch; whether the more *ſpirituous* parts go to the forming this Liquor, the greater its motion muſt be; and whether or no in this our common *Experience* is verify'd; then again we might turn to our Proverb, *Soon Ripe, Soon Rotten,* and ſee whether or no in all reſpects it agrees with the Nature of theſe Bodies; whether, if the Principles of *Vegitables* are extream volatile, and able by their quick motion to bring the Body to a ſpeedy *Perfection,* they will not likewiſe by the ſame nimble motion, or rather *fermentation,* quickly reduce the ſame Body to a rotten ſtate, ſince Bodies are then putrid, when they have loſt all their moſt volatile parts, and nothing but the moſt craſs Principles remain. I could here pleaſe my Fancy with the Conſideration on the diverſe ends of *Vegitables*, ſome whereof I find to dry away, and leave nothing but a wither'd *Skeleton,* whilſt others end their Vegitation in a putrid ſtate, and after they have pleas'd our Taſte, offend our Smell; the Pores of ſome I might conſider *coarctated* by ſulphureous Particles, which hinder the *Exit* of the Phlegm, which diſſolving the Salts, ſuffering the *Avolation* of none but the moſt volatile, cauſes a reſolution of the mixture into a putrid *mucilage*; of this Claſs are *Purſlain, Luituce,* &c. others I ſhould find leſs ſulphureous, and theſe with free Pores, by which the watry parts would get an eaſy paſſage; but the ſaline being deſerted, would be forced to keep their Lodging, that theſe Bodies dry away, having no moiſture remaining, ſuch are *Nettles*, *Sorrel*, &c. But all this I ſhall here omit.

omit, to make room for the diverſity of ſapid Bodies, and *Taſtes*,

Which wholly proceeds from the *variety* of the Particles of ſapid Bodies; for according to the different Structure, and other Diſpoſitions they have acquir'd, they will with greater or leſs eaſe, *&c.* move the *nervous Filaments* of the Tongue; if theſe are extreamly penetrating, they cauſe a deep *Perception*, and ſo on. The Salts of Bodies being ſharp and rigid, are fitted for a *pungent* Impreſſion, and therefore a ſharp Taſte; but the figure of Salts being almoſt as various, as the mix'd Bodies they are contain'd in (and from their *figure* 'tis that the Nature of Salts is to be known, and all their *Effects* clearly underſtood) the *Taſtes* likewiſe of all Bodies muſt vary; and hence one is *ſweet*, another *bitter*, another *ſour*, another *ſalt*, &c. all which Qualities are produced by a variety of *Mixtures*, and *Modification* of the Principles of each Body; for in ſome *Acids*, others *Acrids*, others again *ſalſe Salts* abound; ſome are more *ſulphureous* than others; and certainly an *Acid*, or any other *Salt* whatſoever, if ſurrounded with *Sulphurs*, can't cauſe ſo lively a Punction, as if extricate they would; *earthy* Particles, if they abound in mixtures, do ſo embaraſs the ſaline Principles, as often to make ſuch Bodies *inſipid*; *Phlegm* abounding, cauſes a *diſſolution* of the Salts, and conſequently a *diminution* of the taſte of ſuch mixtures. But to be more particular, Firſt, I take the *Sourneſs* perceiv'd in a great many things, both of the *Animal*, *Vegitable*, and *Mineral* Kingdom, to proceed from the great quantity of *Acids*, wherewith theſe Bodies abound: *Vinegar* is therefore ſour, becauſe its Particles being *Acid*, i. e. of an oblong, rigid, *acuminated figure*, are fit for cauſing a *Pungency* in the parts of the Tongue, and the greater, the more conſiderable is their Maſs, and the leſs they have of *Sulphur*, which hinders and diminiſhes the Effects of thoſe Bodies they take up with: Hence all Liquors abounding with *Acids*, in any quantity, by ſtanding become ſour; becauſe by a continual *Fermentation*, the ſulphureous part is precipitated, and if any *Sulphurs* ſtill remain, are much attenuated, as alſo the volatile Principles are diſſipated, ſo that the *Acids* gain a greater bulk by joyning together.

Secondly, The *Sweetneſs* of Bodies is likewiſe an Effect of the conſtituent Particles, which may be ſuppoſed of a rigid, oblong, and *acuminated figure*, intricated by craſs *Sulphurs*, which hinder 'em from a deep deſcent into the Pores of the Tongue, and conſequently from cauſing ſo great a *Punction*, as in ſour Bodies is obſerv'd; that the Spirits are only *ſmoothly* ſent back to the Brain, from whence the *ſapour* of ſweet Bodies is eſteem'd grateful; ſo *Sugar* is ſweet, becauſe its *Acids* being entangled by thick *Sulphurs*, are not capable of deeply irritating the Fibres of the Tongue.

The ſame in proportion of other Bodies, in which this Taſte is found.

Thirdly, The *Bitterneſs* of other Bodies is no leſs deducible from the figure of the Salts wherewith they abound, than the forementioned Effects are; and therefore 'tis that they excite the Taſte we term *bitter*, when put in our Mouth, becauſe their Particles are rigid, of an oblong figure, pointed at one only end, the other being bound up in *earthy*, and faſtened by *ſulphareous* Particles, *i. e.* theſe Salts are a Compound of *Acid*, *Sulphureous*, and *Earthy* Parts; for *Acids* joyning with the *ſulphureo-earthy Globules*, are half bury'd in 'em, that when on all ſides they have got into the Pores of theſe Balls they form an *undique acuminated* Particle, whoſe Center is *globulous*; now that this figure is capable of rendring thoſe Bodies of this *bitter* Taſte, which are compounded of 'em, we ſhall conceive, if we conſider *Bitterneſs* nothing but a corroding and grating *Impreſſion* of ſome Particles, on the *papillary* Tunicle of the Tongue; for the Production of which Effect, nothing is of a more proper figure than the above-mentioned Salts, ſince they (having a Surface *unequal)* by tnrning about their Center, (as 'tis neceſſary they ſhould when mov'd) with their ſmall *Prominencies*, grate the Surface of the Tongue, and ſo form a *bitter* Taſte, from an unequal and reiterate Reflux of the Spirits to the Brain. For this reaſon *Gall* is *bitter*, and all other mixtures abounding with *Acrid* parts, as *Wormwood*, *Centaury*, &c.

Other almoſt innumerable differences are found in Taſtes, proceeding from the various mixture of theſe different *Salts*, and their diverſe *Conjunction* with the *Earthy*, *Phlegmatick*, *Sulphureous*, *Mucilaginous*, &c. parts of mixtures. All *ſalſe* Principles, becauſe ordinarily of a bulk more conſiderable than either *Acid* or *Alkaline* Salts, if extricate, excite an ungrateful ſapour, becauſe a too violent motion in the Tongue; but if they moſt participate of the *Acid* Nature, becauſe fitted for a partial Punction, and ſomething at the ſame time of Corroſion, their Taſte will be harſh; if they have leſs of this Corroſion, the *Sourneſs* will be more remarkable, as in *Sorrel*, whoſe Salt is an extricated *Salſo-Acid*. If your *Salſe* inclines more to the *Acrid* Nature, it will by turning round its Center grate the Surface of the Tongue, by a ſucceſſive motion of the Fibres, with its different Points, and hence riſes a more than *Alkaline Bitterneſs*; laſtly, theſe Salts abound in all ſorts of Poiſons, and are fitteſt for corroding the Vital Parts, cauſing *Extravaſations* of the Blood, and from thence *Inflamations*, *Ulcers*, *Gangreens*, &c.

Thus the *diverſity* of Taſtes is deriv'd from the diverſe Natures and Modifications of Salts, that we can't falſly infer, that all the other *Elements* in mixtures are *inſipid*; the *Phlegm* is ſo allow'd to be by all, unleſs it obſtinately retain a *Tincture* of the ſame Salts, which before the Diſtillation went to the compoſure of the mix'd Body, and then it has the Taſte (tho' in a leſs degree) the mixture had when undiſſolv'd, which yet does not always happen. *Sulphur*, or the *Elementary* Oil, is alſo *inſipid*; for its parts being ſuppoſed *flexil*, and *lubricate*, are moſt unfit for ſticking in the nervous Tufts of the Tongue, much leſs for irritating them; yet that our common *Oils* and *Mucilages* have a ſufficient Taſte, I ſhall not deny, but ſhall attribute this Effect of 'em to nothing but the Salts they hold embaraſs'd. *Earths* may be thus likewiſe conſider'd; for theſe, if vehemently preſs'd by the Fire, will ſometimes be rendred wholly *inſipid*.

But we obſerve that the ſame Taſtes are not always alike grateful; and again, that ſome Taſtes are to ſome grateful, and to others ungrateful, and conſequently that it can't proceed from the Reaſon now cited. That the Reaſon for the variety of Taſtes, in reſpect to *Individuals*, undoubtedly comes from the Organ it ſelf; for thoſe certainly who have this Organ moſt *ſenſible* (and the thinner is the Coat of the conſtitueſt Fibres, the more fine and ſenſible will the Organ be, ſince that is the moſt ſenſible which is with the greateſt eaſe mov'd, and follows the *Impreſſion* of the leaſt motions) are delighted with no Taſtes, but thoſe whoſe parts have the gentleſt motion, and are moſt embaraſs'd, and therefore not able to penetrate far into their thin Fibres, and ſo cauſe a violent Reflux. If the Fibres of this Organ are thicker, and more compact, they receive with pleaſure the *Impreſſion* of more rigid Principles. *Children* have their Organs more ſenſible, and their Fibres tender, and are pleas'd with none but moderate *Sweets*, as *Sugar*, *Sweet-meats*, &c. *Labourers* have parts more rigid and ſtiff, not eaſily to be penetrated; and therefore theſe can be beſt contented with your more extricate Salts, and ſtrongeſt Taſtes. Thus you may go on with theſe *petit* differences *ſine fine*.

What has been already ſaid of the *ſaline* Principles changing the Taſtes of Bodies, will be eaſily conceiv'd by one that will but attend to the *gradual* changes of Fruits, for *Cherries*, *Plumbs*, &c. which when green and immature are ſo harſh and ungrateful, (their Principles before *depreſſed*, being by the more lively Heat of the Sun *exalted)* become ſweet and delightful to our Taſte, nothing of their former harſhneſs remaining. So an *Apple*, if we conſider it thro' each degree of its *growth*, we ſhall find that at its firſt *Formation*, the Flowers being fallen, it is of a *bitter* Taſte, and for no other reaſon than that its *Acid* is then fix'd in, and overwhelm'd with *terreous* Particles, by this means forming an uneven *Surface*, by diſtinct Points, which ſucceſſively moving, or impreſſing the *papillary* Tunicle of our Tongue, induces a grating and biting Senſe; but when they come a little better to deſerve the Name of *Apples*, and draw nigher their *Maturity*, they by degrees fermenting, get looſe from the *Connexion* of theſe terreous *Molecules*, by that means being fitted for a deeper *Punction*; and by this time they acquire a *vitriolic* harſhneſs, ſtill retaining ſomething of their grating Nature, but at the ſame time more *Pungent*, on account of the fix *Acids* made rough by the *oily* or indigeſted *ſulphureous* part ſticking to them: When they become *Ripe*, i. e. when theſe fix Salts, by *Fermentation*, are diffracted and leſſened, they then have a more pleaſant Taſte, a moderate *Acidity*, a *Sweetneſs*, or a mixture of theſe two, *&c.* for the thick *Sulphurs*, by the *inteſtine* Heat, as alſo that of the Sun, being diminiſhed, are render'd fit for implicating the *Acid* parts, and hindering 'em from penetrating far into the Tunicles of the Tongue; as a Cloth, twiſted round a Penknife, hinders it from penetrating ſo far into any thing as before it could. The laſt State we can conſider them in is their Rottenneſs, which they borrow from the *Evaporation*, and loſs of the moſt *volatile* parts, the fix *Acids* again taking up their Lodgings in the *terreous Molecules*, and by this means again they become as at firſt, bitter.

I might here give a Reaſon for a thing, which may by ſome have been obſerv'd, to wit, that they can better diſtinguiſh the Taſte of the thing firſt received in the Morning, than afterwards; which *diſtinction* (if there be any ſuch) ariſes from the cleanneſs of the Organ, which at this time is free from any *Particles* of things before received; for often the *Particles* lodge themſelves in the parts of the Mouth, and joyning with what is after receiv'd, make but a confus'd *Perception*, by a different Impreſſion of each of theſe Bodies, and variouſly figur'd *Principles*: So if you put a Perfume into a Recipient, ſmelling before of another, the laſt will loſe ſomething of its proper Scent; for according to that of a Poet,

Quo ſemel eſt imbuta recens ſervabit odorem teſta diu.

There are ſome, as *icterical* People, who think all Taſtes *bitter*, becauſe this Diſeaſe (proceeding from the *Obſtruction* of the *Liver*) the *Gall* is retain'd in the Blood, which joyning with the other *Recrements*, makes them participate of its Nature; ſo that joyning with the *Saliva*, it communicates the ſame Vice to all the *Aliments* receiv'd into our Mouth.

CHAP. III.

Of the Perception of Taſtes.

THIS *Senſe* we all ſtrive to gratify, and think nothing too much to be beſtow'd upon it; whole *Eſtates* are often ſpent in order to pleaſe it, and yet by it we moſt commonly receive the Cauſe of our Deſtruction: It is, moſt true, an *inducement* for our receiving our Nouriſhment, and Living; and then by it we are taught to avoid things otherwiſe might not have been thought injurious, and by it are ſo found to be. Theſe, and various other are its Uſes, and neceſſary Advantages which accrue to us hereby; moſt of which (ſo far our *deprav'd Appetites* will draw us) we convert to our own Ruin; for without conſidering the damage we do our own *Health*, or the diſpleaſure we bring upon our ſelves, we are continually endeavouring to gratify what we ought to ſubdue, and think of nothing more than pleaſing our *Palate*, without conſidering that

Naſcentes morimur, finiſque aborigine pendes.

And in theſe Toys, *O God*, we employ the Time allotted us, for fitting our ſelves for the Fruition of thee, and only leave ſome few and barren Hours for thy Service, when we find we are no longer fit for the Service of thoſe *Appetites*, which will bring us to the State, in which we ſhall then find our ſelves; for certainly, by voraciouſly ingurgitating all ſorts of Things which have but a pleaſing Taſte, we often vitiate all the parts of our Bodies, raiſe immoderate *Ferments* in the *Humours*, by which the Nouriſhment neceſſary for rhe ſolid parts is diſſipated, *&c.* and in few days the whole Fabrick reduced to a State it will be fit no longer to be ſeen in, when each By-ſtander will ſay, *Quantum mutatus ab illo! Lord, how he looks to what he did ſome days ſince!*

Our Taſte hath ſome *Analogy* with our Smell, and their Objects are ſomewhat a-kin, for both are alike affected with only the *ſaline* part of Bodies, that by our Smell we can tell what to our Taſte will be *grateful*, and we can hardly *taſte* any thing, but at the ſame time we *ſmell* it, ſome *Particles* riſing up to the *Membranes* of the Noſe, and irritating them. But the *Action* of Taſtes, here to be conſider'd, is perform'd by the *ſapid* Bodies above deſcrib'd, which diſſolv'd by the *Saliva*, and mollify'd by *Maſtication*, emit many *Particles*, which coming on the Tongue, move its *papillary* Membrane (whoſe Seat, and Make is above deſcrib'd) by vellicating, *&c.* of its *Fibres*; for from ſuch an *Impreſſion* in theſe *Fibres*, the Spirits in them contain'd are driven to the Brain, and there, by their motion in the *Fibres* of that part, excite a *Perception* in the Soul of their firſt *cauſa movens:* Theſe Spirits therefore are the chief and only Inſtrument, whereby the *Soul* knows the things that paſs in the Body; by them it underſtands the various *Diſpoſitions* of each part, and by them it ſtrives to rectify all *Indiſpoſitions*; all inordinate *Motions* in the parts of our Bodies, are by them excited in the *Soul*; that the *Soul* ſeems moſt properly united to the Spirits, and only by them to the Body.

From the *Modifications* requir'd towards the *Formation* of this Perception, 'tis, that we are liable to be deceiv'd by it; for ſince *ſapid* Bodies are to be diſſolv'd by the Spittle, and can't approach the Tongue without meeting ſome in their way; if this be out of order, or deviates any thing from its natural Conſtitution, it makes the things receiv'd by our Mouth participate of the ſame Vice; if this be too *ſerous*, it renders *ſweet* Bodies *ſour*, as *Experience* manifeſts, by clearing them from the Embraces of the Sulphurs, which render'd them ſweet, and by too much diluting them, fits 'em for a deep and lively *Punction*; and for this reaſon Grapes, after a wet Seaſon, from ſweet, degenerate into *acid* and *auſtere*, becauſe the Phlegm, or Rain-water, diſſolves the Sulphurs which gave them their accuſtomary *Sweetneſs*, and extricates their Acids, which are then fit for a deeper *Impreſſion*; and hence your *Vine-Tenders* ſtrive to preſerve the Grape from this Injury.

2. If the *Saliva* be too viſcid, becauſe then improper for any Diſſolutions of the Salts, the Taſte will be likewiſe vitiated, ſince the Salts will act by their whole *Maſs*, and conſequently cauſe rude *Impreſſions*; or elſe if the Viſcidity of the *Saliva* be conſiderable, it will be proper for intricating and embaraſſing the Salts of the *ſapid* Bodies, and by this means make them *inſipid*, ſuppoſing they are but in ſmall quantities receiv'd: After this manner your *Claret* ſtrain'd thro' a Sieve of Sand, becomes, like Water, altogether inſipid, having loſt all thoſe Salts in the Sand which gave it its former *Sapidity*.

3. If the *Saliva* degenerate into a too *acrid* Nature, it will be the cauſe of an ungrateful Taſte, becauſe by dividing and rending the ſulphureous parts (the proper *Function* of this kind of Salts) they diſſentangle, and extricate the ſaline Principles, which (tho' before this Action could only cauſe a gentle and moderate motion in the *Papillæ* of the Tongue) will now produce an ungrateful Taſte, as what has been ſaid will prove. This præternatural Acrimony of the *Saliva*, is often caus'd by an Obſtruction in the *biliary* Glands of the Liver; or elſe thoſe of the *Kidnies*, which likewiſe ſecern an *Acrid*: The ſame thing happens, when the Salts of the *Saliva* have attain'd too great a Volatility. If the Salts of this Recrement be fix, they produce an ungrateful Senſation, as the too great Viſcidity does, by encreaſing the Maſs of the Salts of *ſapid* Bodies.

Theſe are the Natures of the *Saliva*, which render us incapable of judging right of Taſtes; for the Salts of the Spittle being ordinarily more penetrating than thoſe of our *Aliments*, (eſpecially when they deviate from their natural *Conſtitution)* eaſily alters their Nature, and make us eſteem things *ſour*, when they are *ſweet*, &c. The other differences of *Taſtes* are already explicated in the foregoing *Chapter*; this is what I here offer, omitting much, and contracting the reſt, for I ſtudy Brevity throughout; and otherwiſe, here's Matter enough in this one Senſe for a Volume.

A
TREATISE
OF THE
TOUCH.

CHAP. I.

Of its Organ *and* Object.

THIS *Organ* is of no leſs extent, than our Body, and is diſpers'd thro' each part of it, *Internal* and *External*; that to give a perfect *Anatomical* Deſcription of it, were an *immenſe*, but *inſignificant* Work, ſince we have already ſo many curious Pieces concerning it. If you would know the *peculiar Seat* of this Organ, it may ſuffice to refer it to the *Genus Nervoſum*, and *Fluidum Spirituoſum*, in it contain'd; for the Nerves extended to all the parts of our Body, and taking their *Riſe* ſrom the *Brain*, and *Medulla Spinalis*, make up one part of this *viſible Subſtance* our Soul is contain'd in: But to be ſhort, we may conſider the *Perception* which we receive at the Application of any thing, to any part of our Body, to be owing to theſe Nerves, which form (eſpecially on the *Circumference* of our Bodies) ſuch Nipples, or *Nervous Tufts*, as are abovemention'd, firſt diſcovered by *Malphigius*.

The *Objects* of this Senſation are many; and all thoſe Qualities which are capable of any ways moving theſe *Nerves*, ſuch are *Heat* and *Cold*, *Moiſture* and *Dryneſs*, *Hardneſs* and *Softneſs*, *Levity* and *Gravity*, *Smoothneſs* and *Roughneſs*; and in fine, all ſuch Affections wherewith Bodies are endew'd, which may therefore be term'd *Tactil Qualities*, ſince they are all perceiv'd by this Senſe, from the various *Impreſſions* they excite in the Organ; they now ſhall be in order conſider'd.

The *Heat* and *Cold* perceiv'd in Bodies, *i. e.* both the grateful, or ungrateful *Senſation* we have at the preſence of ſuch Qualities, and alſo the *Power* by which they cauſe in us ſuch *Perceptions*, wholly depend on the *Motion*, or *Reſt* of their parts. Liquid Bodies are no longer hot than agitated by the *penetrating* Particles of Fire, or the Rays of the Sun, from whoſe reach when once remov'd, they loſe *ſenſim*, their Motion, and again become *frigid*; hence all Motion will not cauſe Heat, for the parts of *fluid* Bodies are always in motion (this Motion is term'd *Motio Fluidorum)* and yet are Cold; therefore this Motion, whereby Fluids retain their *voluble* State, depending on the *Smoothneſs* and *Non-Connexion* of their Particles, is not ſufficient for the production of Heat. Heat doth not conſiſt in *motu totius*, ſince you may throw a Stone with what motion you can, without heating it. This Quality therefore proceeds from the rapid and violent Motion of the Particles of Bodies, which the greater is their *Maſs*, the hotter they will be. Cold is oppoſite to Heat, and its Nature is to extinguiſh, or diminiſh Heat; for a cold Body apply'd to a hot, leſſens its Heat, as *Experience* evinces, and that by borrowing of it ſome part of its Motion: So a Fire, which continually communicates its Motion to the ambient Air; heats it, but to its own loſs, for unleſs it be ſupply'd with new Fuel, it would ſoon be extinguiſh'd; which would not happen, if its agitated *Particles* did not, by ſtriking againſt the Air, which preſſes againſt them, loſe *ſenſim ſine ſenſu* their Motion, and as much, as they give the *Particles* of the Air, they move; which is according to the Rules of Motion; for a Body in Motion, meeting with another that reſts, muſt move it, according to the Motion it ſelf has. Now it would be hard to conceive how this Body ſhould be mov'd by another, and yet that other loſe nothing of its Motion: The very ſame in Heat and Cold, for the hot Body occurring with another that is cold and motionleſs, either can't move forwards, or elſe impels it, giving it part of the Motion it had, which it cannot at the ſame time give and retain; therefore ſo much of its Motion is gone, as the other receiv'd. The more ſtraight are the Pores of Bodies, the leſs ſuſceptible they are of Heat, becauſe they give free paſſage to the *Materia Ætherea*, the cauſe of all Motion; the narrower likewiſe are the Pores of Bodies, the longer they are in heating, becauſe theſe have ordinarily a very firm *Connexion* of Particles, which are not eaſily diſorder'd by the ſmall quantities of the *igneous* Particles impelling them. But let us conſider how theſe Qualities affect our Touch.

Heat therefore (ſince its produced by the Motion of the *Particles* of hot Bodies) will eaſily be conceiv'd to affect our Organs, if we but conſider the Motion it is capable of communicating to the *nervous Tufts* along the Surface of our Bodies, and adding to their natural Heat, by which the Spirits are ſent to the Brain, and ſo give the Soul an Intelligence of the preſence of ſome hot Body; which Motion of the Spirits, the greater it is, the more hot will the Body be eſteem'd; and the hotter the Body is, the greater will the Reflux be: From whence proceeds the *burning Heat* of Bodies, for the Fibres of the Skin being put by them into a violent *Agitation*, cauſe a violent *Reflux* to the Brain, which excites in the Soul this *Perception* of burning, by which Motion likewiſe the *continuity* of the Fibres of the Skin is broke, and the *Lymph* extravaſaled.

Coldneſs of Bodies is perceiv'd by us, from the *Imminution* of the Heat of the part they touch; for they borrowing Heat from the part apply'd to them, diminiſh the Heat of the part, as much as they borrow from it; and the colder the Body touch'd is, the more Heat it will borrow, becauſe the colder it is, the more Heat is requir'd for the moving it, as a Body in Motion meeting another, the more it loſes of its Motion, the bigger this other is; ſince the bigger this other is, the greater is the reſiſtance to be conquered.

Water, in the Summer time, to our *Hands*, ſeems hot or warm, and at the ſame time cold to our *Breaſt* or *Belly*, becauſe the Heat of the *Hand* is nothing conſiderable, as that of the *Breaſt*, &c. That the Water thus expoſed to the Rays of the Sun, is in a greater Motion than the parts of our *Hand*, or than the *Blood* in our *Hand*, (*a ſanguinis enim calore omnis corporis totius calor provenit*) but has leſs Heat than the *Breaſt* or *Belly*, which are parts bordering on the Heart, and receiving the Blood juſt expell'd by its Contraction; and conſequently theſe parts give of their Motion to the Water, by which they are colder than before; whereas the *Hand* borrows Motion from the Water, which therefore ſeems warm to it. The Water ſeems to our *Hand* colder than a piece of Marble, becauſe the ſame *Particles* of Water ſcarce touch twice the *Hand*, but different ſucceſſively by reaſon of their *fluid* Motion, when the ſame parts of the Marble touch it always, unleſs you rub your *Hand* along the Surface of the Marble, and then this is colder than Water, as Experience teaches; becauſe different *Particles* receiving Motion continually from the *Hand*, it loſes more in moving ſo many ſucceſſively, than if only one part was fixly touch'd; ſince ſuch a *reſiſtance* requires ſuch a quantity of Motion for overcoming it; ſo that if the *reſiſtance* be renew'd, (which happens as oft as you ſhift your *Hand* from one part of the Subject to another) the Motion for overcoming of it muſt be renew'd, and conſequently your *Hand* will loſe more of its Motion, and the Body ſeem the colder: Hence the Water is not ſo ſoon heated by the *Rays* of the Sun, as a piece of Marble, nor a great quantity of Water, as a leſs.

Some one may here ask me, Why the Air is hotter at ſome times than at other times? That the greater, or leſs Heat in the Air is deriv'd from the greater, or leſs quantity of Motion it continually receives from the *Rays* of the Sun, for which reaſon 'tis hotter towards Noon than at Night, in *Summer* than *Winter*, in the full Pow'r of the Sun, than where its *Rays* are infring'd; becauſe the *Cauſa Movens* is farther remov'd at Night than Day, in *Winter* than *Summer*, &c. We perceive theſe diverſe *Conſtitutions* of the Air, becauſe when it is much agitated by the Sun's *Rays*, it has more Motion than the parts of our Body to which it is contiguous; ſo that then it beſtows ſome Motion in our Bodies, which makes us in *Summer* ſo hot: If on the contrary, the Sun be not near enough to give it that conſiderable *Agitation* (as in Winter when its parts are almoſt in reſt) its Motion is leſs than our Bodies, and borrows, and conſequently ſeems cold, and the more cold, the more Motion it borrows from us. An Effect of this want of Motion, both in the Water, and Air in the Winter time, may be thought the *Froſt*, or *Concretion* of the Water into *Ice*, which can proceed from nothing but the defect of the Motion of the Sun's *Rays*, now too far off to influence theſe *Mediums*; for the Pores of the Water (the *Cauſa Aperiens* remov'd, *i. e.* the great *Agitation* of the *ſubtile Matter*) are become *reſtrict*, or narrower, for 'tis the *Materia Ætherea* moving backwards or forwards, which preſerves them open, and which now remov'd they gather cloſer, by which the groſs part of the Air, always contain'd in the Pores of the Water, is *coarctated* and preſs'd *undiquaque* by the oval Particles of Water, and conſequently the *Fluidity* of the Surface of the Water is loſt, the Particles having now no room to move in; and this groſs Air cannot get loſe, by reaſon of the preſſure of the condens'd, and in a manner motionleſs *Atmoſphere*, whoſe *nitrous* Spirit may be ſuppos'd to have a hand in this Buſineſs, and more *conſolidate* the *Concretion*, which at the approach of the Sun begins to ſlacken, for then the *ſubtile Matter* begins again its Agitation, and amplifies the reſtrict Pores; from which *Reſtriction* of the Pores 'tis that the Water congeal'd is render'd *opacous*. The Water is dilated by *Congelation*, and takes up a larger place than otherwiſe, becauſe the groſs part of the Air, in the Pores of the Water, by its *Elaſticity* expands it ſelf, and conſequently raiſes the Water higher in the Veſſel; and hence it is that Water congeal'd, is lighter than the ſame quantity of Water not congeal'd. We may obſerve certain *Bubbles* in the Ice, which farther confirm this Opinion of *Congelation*; for theſe can be nothing but the Air dilated, which filling up the *Interſtices* of the Water, deprives its Particles of their Motion: Now that the Air has more *Reſſort* and *Elaſticity*, when the Motion of the *ſubtile Matter* is leſs, will be found, if we conſider its Pores then leſs, (the *Materia Aperiens* having leſs Agitation) for the leſs are the Pores the more ſtrict will the Particles be, and fitter for a greater *Expanſion*, which is ſuppos'd a Property of the Air when preſs'd. We ſhall eaſily draw a Reaſon from this *Hypotheſis*, for the more eaſy *Concretion* of *Oils*, *Greaſe*, and other viſcid Liquors, than the more thin, ſince the Motion of theſe being leſs, it will more eaſily be loſt. Your *ſpirituous* Liquors, as *Brandy*, &c. will not *congeal*, becauſe of their *intrinſick* Motion, which is continual, and the Air contain'd in their Pores more ſubtile. Many other ſuch *Phænomens* I might here relate, for the *Explication* of all which, this *Hypotheſis* ſeems moſt aptly contriv'd; but I have already made too large an *Excurſion.* To return, The ſame Rule will ſuffice for Heat and Cold, as for the *Explication* of Motion and Reſt; for if a Body in *Motion*, meeting with another, moves it reſpectively to its own Motion, and the *Reſiſtance* of the Body to be conquer'd, *i. e.* if a Body in motion can only communicate its Motion, in ſuch a *proportion* to an occurring Body, reſpect being had to the *quantity* of its *Motion*, and the bigneſs of the *Body* met with; I ſay, after the ſame manner, a *hot* Body of ſuch a determinate Heat, can only beſtow ſuch *proportionate* quantity of its Motion to an occurring *Frigid*, i. e. that the *cold* Body can only borrow a *determinate* Heat of an *hot* one, reſpect being had to the Motion of one, and Coldneſs of t'other; and the *hot* Body loſes juſt ſo much of its *Motion*, as the other is capable of borrowing.

The *Solidity* and *Fluidity* of Bodies, are Qualities next to be conſider'd, which ſeem to include two other *Tactil Species*, viz. *Siccity* and *Humidity*; the firſt belonging to hard and ſolid Subſtances, the ſecond to Fluid. The Nature of hard Bodies conſiſts in this, That they reſiſt the Touch, not yeilding to the preſſure of our Hand, or other Parts; the contrary of which is obſerv'd in fluid Bodies, which are eaſily divided, and yeild; the other being hardly ſeparable, and keeping their figure conſtantly the ſame, without the help of a *Continens*; whereas, fluid Bodies diffuſe themſelves on all ſides, unleſs kept together by the means of a *Vas Continens*. *Soft* Bodies are a Compound of hard and fluid, they yeild if compreſs'd, ſpread and diffuſe themſelves, if not limitted. There are different degrees in *Softneſs*, for ſome reſiſt the Touch more, and approach nearer the Nature of ſolid; theſe likewiſe do not ſo much diffuſe themſelves; others are more of the Nature of fluids, and ſofter, more eaſily divided. Theſe are the moſt obvious Qualities of theſe Bodies, we may now ſee by what means they are produc'd. Firſt, Hard Bodies reſiſt the Touch, becauſe all, or the beſt part of their Particles are ſo connected one with the other, that they can't eaſily be ſeparated, nor yeild to the preſſure of any thing apply'd to their Surface; this ſtrict *Connexion* is alſo the cauſe of the *Reſt* of the parts of Bodies, that the greater is the *Reſt* and *Union* of their parts, the more ſolid they are. Secondly, Liquid Bodies yeild to the Touch, and cannot preſerve their *Station*, becauſe their Particles are in a continual Motion, and perpetually agitated by the *ſubtile Matter*, always rapidly moving in their Pores, and ſtirring their *Parts*, which are weakly, or no ways connex'd one with another; that the more theſe Particles are agitated, and the greater their Motion is, the more fluid the Bodies are. Thirdly, Soft Bodies give ſome way to our Touch, and alſo are apt to change their Poſition, in as much as they have ſome Particles in a *perpetual* Motion, whilſt others reſt; and theſe, the more parts they have in Motion, the ſofter they are. Let us apply this to our Touch, and we ſhall find that hard Bodies are ſo perceiv'd, becauſe by preſſing ones hand on them, they cauſe a Motion in our Fibres, and a *Cedency*; whereas, they neither move nor yeild; for our hand is ſoft, and a Compound of hard and fluid, but they of ſolid only, which can't yeild, but the whole *Series* of their parts muſt change their place. Liquid Bodies are ſo perceiv'd, becauſe our hand makes them yeild, it ſelf not being mov'd, for the Particles of theſe Bodies are continually a moving up and down; and when preſs'd on one ſide, quickly betake themſelves to another, where there is leſs Reſiſtance. Soft Bodies are perceiv'd to have a middle *Conſiſtance* between *fluid* and *ſolid*, ſince their Particles yeilding ſomewhat to the hand, or other parts, do not cauſe ſo great *Compreſſion* of the Fibres, nor ſo ſtrong an *Excluſion* of the Spirits, as the *ſolid*, but a greater than the *fluid*. We perceive the Moiſtneſs, or Humidity of Bodies, by their wetting the parts, and ſticking to 'em, and in their Pores, by that means cauſing a continual, tho' ſlight Reflux, for the time they thus remain, and 'till they are ſtruck off by the inſenſible *Perſpiration* and *Motion* of the Air, and *ſubtile Matter:* *Siccity* depends on a ſimple Reflux, and no longer is continu'd than the part remains on the dry *Surface* of a Solid, ſo that theſe two are *Effects* of ſolid and fluid Bodies. I ſhould here go farther in the Nature of theſe Qualities, but that the others call for me, and I am afraid of *Prolixity.*

The third Pair of Qualities to be weigh'd is *Levitas* and *Gravitas.* *Gravity* is a *Tendency* of Bodies to the *Center*, from an *external* Reſiſtance; *Levity* on the contrary is a want of this *Tendency*, as being not capable of receiving the Reſiſtance any external Body can give it. Theſe therefore are Qualities, and *modi eſſendi corporum*, whereby one is driven towards the *Center*, the other from it; mark here, that heavy Bodies have no natural Tendency to the *Center*, nor Light upwards, (for all Bodies naturally are inclin'd to preſerve themſelves in their preſent way of exiſting) but being compelled by an *external* Force, ſome are ſent downwards, and are term'd heavy, others upwards, and are called Light; ſo that nothing can be ſaid with the Poet,

Preſſum eſt gravitate ſui.

But theſe are often *Modes* of Bodies reſpectively, and one Body is light in compariſon of an heavier, &c.

From theſe *Deſcriptions* we may gather, that the Nature of theſe Qualities, conſiſts in the *reſiſting* and not *reſiſting* of the Air, and *Æthereal* Matter; and therefore compact Bodies are heavier than others, becauſe they moſt reſiſt the paſſage of the Particles of the *fluid* and *agitated* Matter, which the more it is reſiſted, the more force it beſtows.

We perceive the weight of Bodies by the force neceſſary for moving them; for a Body, whoſe *Tendency* to the *Center* is double to that of another, requires a double force to conquer it, *&c* that the *Soul* may be ſaid to gueſs at the weight of Bodies, by the quantity of Spirits it employs to move them; for the *Soul* experimenting that ſuch a quantity of Spirits being ſent into a *Muſcle*, by contracting it, will heave ſo much, does not find it difficult to determine by them the weight of Bodies; then again, the Reflux caus'd by the Motion of the Nerves, and Compreſſion of the *papillary Tunicle*, which varies according to the weight of Bodies, is the beſt help to the Soul in his judgment of their weight.

Smoothneſs and *Roughneſs* are *Tactil* Qualities, and perceiv'd by this Senſe; the one, when the *Surface* of Bodies is ſo unequally diſpos'd, that ſome parts of it are depreſſed and others exalted. *Smoothneſs*, when the parts have an equal Situation, and are placed in a ſtreight Line one by another, cauſing an even and polite Surface, ſuch as *Glaſs*, *Ice*, &c. The firſt, or *Roughneſs*, is perceiv'd by the *Corroſion* and troubleſome *Vellication* of the Nerves, or when one part of a hand lies in a Valley, whilſt another is roſe higher, *&c.* the other (*Smoothneſs*) excites but a gentle Motion, and lets the part apply'd to it glide ſmoothly along. So much for the *Tactil* Qualities, or the more obvious ones, obſervable in moſt Bodies, I ſhall now conclude with a ſhort Explication, and Conſideration of this Senſe.

CHAP. II.

Conſiderations on the Touch.

OUR Touch is unlimitted, diffus'd thro' each the moſt minute part, and is a Senſe whereby we are moſt delighted, and alſo ſuffer the moſt: It is form'd by an Impreſſion of *Tactil* Objects on the proper *papillary* Coat, or Membrane, in whatſoever part of our Body; which Objects, if they make our Fibres and Fleſh yeild to them, are term'd *hard* and *ſolid*; if they give way, *fluid*, or *ſoft*, &c. if they ſtrike gently our *Organ*, and cauſe no great *Concuſſion* in the Fibres, the Perception may be grateful, as a gentle *Softneſs*, a moderate *Warmth*, a ſlight rubb of a *ſmooth* and *fine* Matter, becauſe the refluent Spirits excite but a light and titillating Impreſſion in the Fibres of the Brain: If, on the contrary, the Objects impel with Violence our Organ, and diſſolve in a manner the *Connexion* of the Fibres, whether by *Impulſion*, *Preſſion*, *Tenſion*, *Sciſſion*, *Fraction*, *Diviſion*, *Burning*, &c. the *Perception* thence reſulting will be ungrateful and troubleſome, becanſe the Spirits will be violently driven back to the Brain, and conſequently cauſe a great *Divulſion* in the Fibres.

Thus are all *Senſations* perceiv'd by the Soul in the Brain, this is a reflux in the Spirits excited, more or leſs violent according to the *Objects Motion*; which Motion of Body is to be perceived by the *Touch*, in as much as they cauſe *ſucceſſive* impreſſions, on different parts of the Fibres they move on; we can likewiſe by the Touch diſtinguiſh the various figures of Objects, as *Sharpneſs* by the *pungency*, and all the other figures by their reſpective *Draughts*, and by the knowledge we have of all their Parts. The *Magnitude* likewiſe of Bodies is perceiv'd or gueſs'd by the Touch, from the *extremities* Terminated on various Fibres of our Hand, or other parts; or if it be large from the Time our Hand, *&c.* is in running over its ſurface, with ſuch a quantity of *Motions.*

Blind Perſons have the greateſt perfection of this Senſe, and can ſometimes diſtinguiſh ev'n *Colours* by it; (as ſome have obſerv'd) but it is what I ſhall hardly Credit; all figures of objects they perfectly know by the Touch, as *round*, becauſe they find their hand moves round, not occuring with any Prominency, but gradually deſcends, and riſes; *Square*, by the Extremities equally ſituated from each other, and the Corners equalling the Sides; *Triangular*, from the three Angles or Corners parting the three ſides, and that whether *obtuſe Rectangular*, or all *Accute*, from the *Collateral Situation* of the Parts; *Quadrangular*, *Pentagone*, *Exagone*, *Eptagone*, *&c.* All come under their knowledge after the ſame manner, and no otherwiſe than known by the *Sight*, are they known by the *Touch*; for as the Rays of Light from many Points of the *Angles*, &c. form'd on the *Retina*, the Image of each *Angle*; ſo in the Touch, each Angle apply'd to any part of our Body cauſes ſuch a Motion in the Fibres, as induces the Soul to judge the Objects pointed, if they only have one ſharp and thin point from the pungency they affect the *Fibres* with all, by which the Spirits are ſent ſmartly to the Brain, and cauſe an Acute impreſſion in the *Fibres* there, and the more, the more ſharp was the Object: If the Objects end be *Obtuſe* the reflux will not be ſo ſmart, but will cauſe an *Obtuſe Impreſſion* in the Fibres of the Brain: If the Objects have three, four, &c. *Angles*, they will be diſtinguiſh'd as above: ſo of all other *Figures* of Bodies whatſoever, the knowledge of the *Magnitude* of Bodies and alſo of each part of Bodies, is eaſily attain'd, and particularly belongs to this Senſe, being no otherwiſe, then by Meaſuring, perfectly underſtood: But theſe Qualities are beſt by the Blind perceiv'd, (as to the Touch) becauſe they wanting the Sight are forc'd to attend to each the leaſt Impreſſion which happens in their Touch, and by theſe Obſervations Perfection is attain'd to in this, as well as all other Things.

A
Short and Concluding
DISCOURSE
CONCERNING
Hunger and Thirſt.
WITH
Some ſhort Obſervations concerning
SLEEPING and WAKING.

SO far I have try'd to explicate, and lay before the Reader, in as plain Terms as I could conveniently, the *Hiſtory* of the four *Principal* Senſes, or thoſe which by all are allow'd to be; I think now of adding ſomething concerning *Hunger* and *Thirſt*, which by many are Rank'd amongſt the *Senſes*; and as I imagin not amiſs, neither can we conceive how a *Senſitive Appetite*, ſhould be ſtirr'd up to a deſire, unleſs ſome Object be reprepreſented to it, on which to fix this deſire; and therefore we muſt conclude that theſe are both *Appetites* and *Senſes* ; for certainly if *Hunger* and *Thirſt*, induce a deſire of Meat and Drink, no doubt but they preſuppoſe a *Senſe* of their want ; and ſo when we have once a ſenſe of theſe things, and conſider the good they will do us, we are neceſſarily induc'd to a *deſire* of them, in order to remove the troubleſome *Senſation* brought by their want.

An *Appetite* may be either taken to ſignifie an *Irritating ſenſe*, caus'd in the *Soul* by a Motion in the Parts of the *Stomach*, and *Mouth* ; or a Motion of the *Soul* by which it is carried to a deſire of ſome *determinate* kind of *Food* : Many things therefore concur to the exciting of *Hunger*, as 1. A *Saline Humour*, participating of an *Acrimony*, Irritating the *Tunicle* of the *Ventricle* and *Palate*, *ſticking* in it like Needles. This *Humour* is deriv'd from the Glands of the *Stomach*, and its ſaline part, which is a *Volatile Salſo-Acrid*, cauſe the *Vellication* ; yet farther the *Salts* of the *Saliva* have the ſame Nature, ſo that the ſame Irritation is communicated to the Tongue, and from thence, by the *Fibres*, convey'd to the Brain : The principal Seat therefore of Hunger muſt be referr'd to the *Filaments* and *Nervous* Tunicle of the Stomach, to the higher *Orifice* of the *Ventricle*, and the *Papillary* Membrane of the Tongue ; both which places are of a moſt exquiſite Senſe.

Secondly, The Spirits occur neceſſary to the production of Hunger, for theſe tranſlate this *vellication* to the Soul, thus warning her to conſult the conſerving of the *Machine* and *Claiy Tenement*. 3*dly*, This continual *reflux* of the Spirits, caus'd by the *Vellication* of thoſe Salts, being Troubleſome to the Soul, it is forc'd to think of ſome means of removing it ; and ſo of Eating, and receiving ſome *Aliment*, which being Chaw'd in the Mouth, and let into the Stomach by degrees leſſens the Hunger. Infine, ſo long as any *Vellicating* Salts remain unintangled, ſo long will the deſire of Eating remain, and ſo long we ſhall with Eaſe and Pleaſure receive our prepar'd *Aliments*. Infants when they find any *Vellication* in theſe parts, altho' they can't refer it to the parts Affected, yet are determin'd by Cuſtom to the deſire of Meat ; for when they find that the *Milk* from the Breaſt mitigates the uneaſy ſenſe caus'd by its abſence, and eaſes the parts they are invited to a frequent deſire of it : So that 'tis Uſe alone which determines us to ſo various Nouriſhments ; for what I find beſt and ſooneſt to relieve my Hunger, ſuch things I am invited to receive.

But we are not always hungry ; becauſe thoſe Salts which were the firſt cauſe of it, have their State much alter'd by the receiv'd Nouriſhments; for the Meats we eat being roll'd about the Mouth Abſorbs and takes with it the *Salts*, the moſt apt for irritating the parts

(ſince theſe the moſt eaſyly ſtick in its pores) and carry them into the *Stomach*, where they likewiſe take with them the *Stomatic* it *ferment*, and with it under the form of *Chyle* gets into the Blood ; which with its *viſidity* it does not a little incraſſate, thus intangling the *volatile* parts ; from whence we are ordinarily more frigid after, than before Eating ; for this ſupply of *Chyle* thickening the *Blood* leſſens conſiderably its motion, from which all *Heat* in Bodies proceeds : Then alſo we are more *Drowſy* after Eating, becauſe the *Blood* being thick by reaſon of the advent of the *Chyle*, the thiner and more *extricate* Parts are again intangled, and conſequently the ſeparation of Spirits in the Brain leſſen'd, which otherwiſe are the cauſe of *waking*, as below will be manifeſted. This *Meat* therefore under the form of *Chyle* getting into the Blood, thickens it and imbaraſſes the *volatile* and *pungent Salts*, making them unfit for their proper *Functions* ; till at length by Circulating, this *Chyle* is brought into leſs Parts, and the Salts are again Extricated, and fitted for their former Works ; ſo that *Hunger* at length returns the Salts again, irritating the Tunicle of the *Stomach*. *Young Children* are ſooner Hungry than other People, becauſe what they Eat being moſtly Liquid, ſooner gets out of the *Stomach*, and does not ſo much incraſſate the Blood, whoſe *fermentation* is lively ; thoſe alſo who uſe much Exerciſe are ſoon Hungry, becauſe the Blood being in a greater

Motion ſooner extricates its *Saline* Parts, and renders it fit for its reſpective uſes.

Some are not *Hungry* till towards Evening, becauſe their *Blood* in the Morning is either too much *Diluted*, or too little; if too much, the Salts are ſo much waſh'd as to be unfit, for any conſiderable *Irritation*, if the Maſs of Blood is viſcid, the *Saliva*, and *Stomatic* ferment will likewiſe be viſcid; from whence no great Hunger will be caus'd, becauſe the *Sulphurs* keep then entangled the Salts, and render 'em unfit for their effects: So that there requires that theſe People uſe ſome Motion before they be *Hungry*; for firſt by Motion the weary Part is Evaporated; and by Motion the thick Sulphurs are diffring'd; therefore at Night or there-abouts the *Stomach* comes, becauſe of the exerciſe us'd in the Morning, *&c.* In fine, uſe has ſuch power with us, that they who are accuſtom'd to Eat much in the Morning, are then always *Hungry*; and on the contrary: 1*ſt*. Therefore, ſuch as riſe very betimes, and labour in the *Morning*, are then Hungry, becauſe by thus applying themſelves, the watry Part that diſſolves the Salts, is Evaporated; and theſe are not ſo craving at Night, becauſe of the ſmall time between their Dinner and Supper, which does hardly Suffice to convert the *Chyle* into Blood, which therefore makes it viſcid, and fit to retain the Salts. *Secondly*, They whoſe Blood is of a hot Conſtitution, and by reaſon of its many *Saline*

Particles, continually and violently fermenting, are more tempted with Hunger after Reſt, as in the Morning, *&c.* Becauſe, ſince their Humours are thus agitated all the day long, the *ſaline* part of them will be neceſſarily much diffracted, and alſo much diſſipated; ſo that, that part which remains, will neither in quality nor quantity be ſufficient for cauſing Hunger; for 'tis requir'd, in order to the cauſing of *Hunger*, that the Salts of the *Saliva* and *Stomatic Ferment*, be of ſo great a quantity, and of ſuch a bulk, in order to excite a deſire of Meat; which deſire, as the bulk and quantity of theſe Salts is encreas'd, or leſſen'd, likewiſe encreaſes or leſſens; therefore ſuch People are not hungry 'till ſuch time as theſe *ſaline* Principles are conjoin'd, which is not 'till they have reſted.

3. After long Faſts, and after Time for eating is once over, we are not ſo hungry, becauſe the parts of the *Ventricle*, or the *Seat* of *Hunger*, are relax'd, by reaſon of the want of Spirits to keep them to their former *Tenſion*; for by much Exerciſe, the Spirits are diſſipated, and Meat not being receiv'd, they can't be recruited. Alſo after long Faſts, the Ferment is not ſecern'd; for the Blood now deſtitute of its *Chyle*, the Bridle which hinders its two great *Fermentation*, now ſo violently ferments, as that all the watry part of the Blood evaporates, and is excreted by its various *Colatories*; that the more craſs and dry part of the Blood only remains, which is not fit for paſſing theſe *Colatories*; and what

of it does paſs is unfit for the work deſign'd, and ſo the *Mouth* will be extream dry, from whence Thirſt; and the *Stomach* will be corroded, as one may ſay, by theſe thick and bulky Salts, from whence *Heart-burnings*, and *Pains* in the *Stomach*; then alſo, they who without eating have paſs'd their Time of Dinner, or Supper, are not hungry; becauſe, by the greater Motion of their Bodies and Souls, the *ſerum* of the Blood is conſum'd, and conſequently the Salts are intricated by, and involv'd in the *ſulphureous* part of Blood, that no ſenſe of *Vellication* in the *Stomach*, or *Palate*, and ſo no *Hunger* is excited.

4. It may be enquir'd, Why at the preſence of any Meat, when one is hungry, the Spittle is mov'd, and plentifully pour'd forth into the Cavity of the Mouth? Or, Why at ſuch times our Mouths *water?* (as is the vulgar Expreſſion.) 1. That this is to be fetch'd from the *Inoſculations* of the *olfactory* Nerves in the Brain, with thoſe of the Palate; for the Spirits reflux'd to the Brain, and carrying the Impreſſion of Odours, are again *conſonant* to the Law of Spirits, ſent from the Brain to the part by their *reſpective* Channels; ſo that in this caſe they are not only ſent to the Noſe, from whence they firſt mov'd, but alſo by reaſon of their *Inoſculations* with the foremention'd Pair to the *parotical* Glands, and theſe of the Palate of the Mouth, by which they will be contracted, and conſequently the Spirits will be expreſs'd. 2. Alſo our Mouths *water* at the thoughts of Meat; for by the Law of *Union* of the Soul with the Body, as often as the Soul

thinks of receiving *Aliments*, the ſame Impreſſion will be excited, as if we were really eating; from whence 'tis that the *Saliva* is ſecreted, and preſs'd out of the Glands by the Spirits *contracting* them, as is in eating cuſtomary.

5. You'll enquire, from whence 'tis that ſome ſorts of Meat are *loathſome* to ſome, *&c.* 1. That it proceeds from long *Vſe* and *Experience*, and not ſo much from any *ingenite Antipathy*: They who have *Cheeſe* given them when young, by reaſon of the uneaſy and troubleſome *Senſation* which it then cauſes, often loath it all their Lifetime, *Tenax enim eſt actorum memoria.* So thoſe things which have a ſtrong ſmell, are often left untaſted, and this ſometimes cauſes our *loathing* to ſome Meats: But thus far we may allow of an *innate Antipathy*, as that the Nerves in ſome are variouſly diſpos'd from thoſe in others, and that ſome particular things may be more troubleſome to them, than others are: And likewiſe, ſince the Blood of the Child has always an *Affinity* with that of the Parents, they may alſo have the ſame *Appetites*, and avoid the ſame things. 2. But moſt of all from *Vſe* and *Education*, is to be drawn our *loathing* of particular Meats; for *Infants* commonly fly ſuch things, as they have obſerv'd their *Nurſes*, and others, to avoid; but we can't ſuppoſe that any particular *Paſſion*, or *Affection*, can tranſmigrate from the Mother's to the Child's *Soul*, ſince there is no peculiar Tye between their *Souls*; from whence we conclude, that all ſuch *Affections*, as we call *Pathema's*, deliver'd

ver'd from Parents to Children, *&c.* comes from the like Diſpoſition of their *Humours.*

6. The want of a *Stomach* (which is a *Deprivation* of the ſenſe of *Hunger)* is many ways produc'd; as firſt, by the too great *Aquoſity* of the Ferment diſſolving the Salts, which by their *Irritation* excite a *Stomach*; for the Salts thus diſſolv'd, have not bulk enough to irritate the *Tunicles*, ſo if you pour much *Water* into *Vinegar*, it loſes of its Sourneſs, *&c.* 2. The defect of Water in the Ferment, becauſe then the Salts are intricated by the dry *Sulphurs.* 3. The defect of the Salts of the Ferment, or a change of their Nature; all which things produce an *Inappetency*, ſince the Soul is only brought to a deſire of Meat, by the Irritation in this part. 4. The *Indiſpoſition* of the Organ, for if this be not diſpos'd to receive any *Impreſſion*, no *Hunger* will be excited.

7. A *loathing* of Meats proceeds from an unpleaſant Perception of them, from whence the *Soul* abhors 'em; ſo when we ſee any thing like another, which we deteſt, we in the ſame manner deteſt that. Again, any thing that is troubleſome to the Smell, will not be admitted to the Mouth; and any thing will be more troubleſome to the Smell at one time than another, as often as the *Mucus Narium* is chang'd to a more penetrating *Nature*, for then its Salts joining with the Odours, produce a violent *Irritation.* As to the *Taſte*, likewiſe thoſe things which once were eſteem'd pleaſing, may now ſeem troubleſome, as the *Saliva* is chang'd in its Nature; and of this ſee in the Chapter of *Taſte.*

8. A *Fames Canina*, *i. e.* an immoderate deſire of eating Meat, ev'n when 'tis known that the *Stomach* has not ſtrength to digeſt it, ſo that it is thrown up as faſt as down, *&c.* proceeds from the too *ſaline* Diſpoſition of the Ferment which degenerates, either into a fixt *Acid*, or elſe a very thick and fixt *Salſo-Acid*, which cauſes a more then ordinary *Impreſſion*, and conſequently a more voracious Appetite; to which, if ſatisfy'd with eating, ſucceeds a *Vomiting*, becauſe the Meat preſſing on the *Stomach*, cauſes the Salts to produce a more rude Impreſſion; which the Soul deſiring to remove, ſends Spirits into the *Diaphragm* and *Muſcles* of the *Abdomen*, in order to contract them, which, when contracted, preſs the *Ventricle*, ſo driving upward the *irritating* Matter.

Thirſt is a troubleſome *Perception* of a biting *Heat* and *Aridity* in the Mouth, and *Imæ fauces*; and are therefore the proper Organ of *Thirſt*; which troubleſome Perception is follow'd by a deſire of ſome *frigid* Potulents, and ſo all ſuch things as conduce to the eaſing our Drougth are its Objects. But as many things conduce to *Hunger*, ſo alſo to *Thirſt*; as an uneaſy motion in the Mouth, from whence the *Spirits* are determin'd to the Brain, by which this troubleſome Perception is ſtirr'd up in the Soul, according to the Law of its *union* with the Body; and now the Soul conſulting the Good and Preſervation of the Body, makes choice of ſuch things, as it has, by *Experience*, found moſt beneficial, in order to a removal of this Uneaſineſs.

We may place the proper *Organ* of this *Senſe* in the *Mouth*, and *Throat*, altho' we find that our *Thirſt* is better extinguiſh'd by drinking of any Drink then by a ſimple *Ablution* of the Mouth ; for this is drawn from hence, that by the communicating of this Drink to the *Blood*, it is render'd more fluid, and conſequently the *Saliva* will be more diluted : But our Thirſt is extinguiſh'd by an immediate drougth, in ſo much, as the exæſtuating *Stomach* and *Viſcera* (cauſing Thirſt by the volatile Salts they ſend to the Mouth, which by fermenting diſſipate the watry part of the *Saliva*, ſo leaving it dry, fit for violently moving the Fibres) are by this *refrigerated*, and have their *pores* ſhut : So if you waſh your Hands in cold Water, your Thirſt will be diminiſh'd.

The dryneſs of our Mouth is one cauſe of Thirſt, and proceeds from the Meat, which being chew'd in our Mouth conſumes the *Saliva*, and the Meats then are hardly let down into the Stomach, but lodge in the folds of the Mouth, and thus cauſe a reflux of the Spirits : Or alſo, the *Tongue* being dry and rough, by a want of the moiſtening *Saliva*, rubs the other parts of the Mouth and cauſes a *Senſation*, by which we are determin'd to the reception of ſuch Liquids as will reſtore the former moiſture to the Tongue.

2. After any more then ordinary *Heat* we are thirſty ; for then, the Blood being in too high a *ferment*, the *aqueous humour* of the Blood

and the *Saliva* will be diſſipated ; but when the *Saliva* is left thick and viſcid, is by the breath'd forth Air is driv'n againſt the Membranes of the Palate and Mouth, and ſo cauſes in them an *Irritation* ; but the drineſs of the Mouth may be thus perceiv'd, for the Tongue being mov'd to the other parts,can't but perceive their roughneſs, which grates the *Papillæ* likewiſe dry, by which roughneſs 'tis that we judge the Mouth to be dry, *&c.*

We may hence gather, that there is a ſimple and moderate Thirſt, not hindering the exerciſe of any *Functions*, and caus'd by the *aridity* of the Mouth conjoin'd with a light heat, both which depend on a too great motion of the Blood, by which it's watry and moiſtening part is exhal'd ; and this kind of Thirſt is moſt often caus'd by the *maſtication* of our Meat. Another Thirſt there is we call *Morboſſe*, which induces a violent *Irritation*, with a vehement Heat, whoſe firſt Cauſe may be the eating of extreme hot things, and violent Exerciſes : And in fine, all ſuch things as cauſe a great *diſſipation* of the watry Humour, which, as long as remains any thing in the *Saliva*, keeps the parts moiſten'd, and the *Salts* diſſolv'd, which otherwiſe join, and obtain bulk ſufficient for moving violently the *Fibres*. By this laſt kind of Thirſt we are induc'd to a deſire of any *Liquids*, but they muſt be *frigid* ; in that to a Deſire of any at all.

You'll ask why hot *Liquors* beſt aſſwage our Thirſt? 1. Becauſe they have a greater *Motion*, and conſequently more eaſily diſſolve the *Salſe* Particles ſticking in the Mouth; ſo that theſe do not only extinguiſh our Thirſt for a time, but drive away the very Cauſe of it, which frigids do not, ſo the *Spirit of Wine* better takes off our Thirſt then common Water, becauſe it being *ſulphureous* intricates the irritating Salts, and carry them with it. 2. An *acid Spirit* takes away Thirſt, both in as much as it diſpels the biting *Acrimony* of the *Saliva*, and alſo, in as much as it is *cooling*.

Thirſt is a *ſymptome* of many *acute* Diſeaſes; as *Fevers*, *Dropſies*, &c. and is in all of them caus'd by too great a *Diſſipation* of the watry Humour, either by *Fermentation*, or *præternatural Effuſions* of it. In Feavers 'tis diſſipated by *Heat*, or *præternatural Ferments*; and in this caſe the air from the *Lungs* bring with it the *perſpirated Salts*, which fermenting with thoſe of the *Saliva*, cauſe a diſſipation of the watry part; ſo that the Salts are in a manner *chriſtalliz'd*, and left in a dry form. In a *Dropſy* and *Diabætes*, this watry Humour is depoſited in one by the *Kidnies*; in the other, into ſome Cavity of the Body; ſo that little remains to be ſeparated in the Mouth, that the Salts are almoſt in *ſiccâ formâ*, ever irritating the parts and Membranes of the Mouth, which will be intolerably dry for want of ſomewhat *liquid* to keep it moiſt.

Sleep is a thing which our *frailty* makes neceſſary; and ſince all our Actions depend on ſo eaſily *diſſipable* parts as the Spirits are, 'tis out of a neceſſity requir'd, that we allow ſome time for recruiting, what by living we loſe. We may therefore define Sleep *a total Ceſſation of all Senſation and voluntary Motion,* from a *Defect*, or diminiſh'd Motion in the *Animal Spirits*, not from any fault in the *Blood* or *Brain*; or elſe Sleep is a *Suſpenſion of Action*, and an *Impotence*, in which the Soul is in a manner disjoin'd from the Body, and knows not any thing that paſſes in it. So that we muſt conclude the cauſe of Sleep to be the fault of that part, by which the Soul is united to the Body; *i. e.* the *Animal Spirits*, which by their Motion to the Brain excite in the Soul the *perception* of ſuch things as mov'd their Reflux to the Brain.

The former *Definition* moſt particularly belongs to a moſt profound *Sleep*, which ſeldomer occurs. Our Night-walkers are no ſuch Sleepers, who in their Sleep act ſuch wondrous *Exploits*, as that one can't think but that they ev'n have ſome Thought, tho' confus'd; which Thought we may define ſomewhat like that of *Melancholy* Perſons; in as much as they have ſome Pores of Fibres remaining more open, by more frequent influxes; ſo that when the Spirits move this way they are determin'd by the Impreſſion caus'd, to ſuch or ſuch Actions, and the Spirits are ſent into the parts in order to perform them: But ſtill we muſt conclude, that theſe People are ignorant of what they have done in their Sleep, ſince we find, that when they are awak'd in these Pranks they are ſurpriz'd.

We may define an imperfect Sleep to a *want of Power to any Perception or voluntary Motion*, from a Defect or diminiſh'd Motion of the *Animal Spirits* ; ſo that we ſleep ſo long as there is a want of the Animal Spirits. We obſerve therefore firſt, that we are inclin'd to ſleep after eating, becauſe the Belly, *i. e.* the *Ventricle* being fill'd, the Blood has not ſo free a paſſage down the *Aorta*, it being behind the Stomach, and therefore muſt be compreſs'd by it when it is *turgid* with *Aliments* ; ſo as the Blood will not in its uſual *quantity* deſcend, but more plentifully aſcend towards the Head and other parts ; as every one may in himſelf diſcern ; for after a hearty Meal ones Head ſeems more ſtuff'd, and the Face redder and hotter ; the ſame of the Hands ; but the Blood thus ruſhing to the Head, compreſſes the Glands of the Brain, and hinders the free *ſeparation* of the Animal Spirits by them. By this we may add the mixture of the thick *Chyle* with the Blood, which intricates the Volatile, and extricate part of it, which might otherwiſe be ſecern'd by the *Glands* of the Brain, 2. We ſleep after long Journeys, becauſe by Motion the Spirits are diſſipitated (for ſuch a quantity of ſpirits is neceſſary for every *muſcular Motion*) and conſequently the Parts and Members are relax'd, as the Brain, *&c.* which then according to ſome ſubſides and hinders *animal ſecretion*. 3. We are ſleepy after long Watches for the ſame reaſon, and becauſe the Brain being relax'd by the want of Spirits (which keeping *turgid*, the Fibres are the cauſe of all the Stiffneſs and Straitneſs of our Body) the dull *Serum* inundates in the Brain. 4. We ſleep at a pleaſing *Murmur*, becauſe it makes *tranquil* the *Animal Spirits*, by keeping off all *vexatious* Thoughts. Thoſe that ſleep much, grow fat; and on the contrary; becauſe when we ſleep our Blood has not ſo much *motion* (the Spirits, which otherwiſe are the ſpur which ſets it a fermenting, being ſtill) and therefore its *ſulphureous* part is not ſo much diſſipated, and acquire a ſufficient Conſiſtence, and alſo, have time by circulating thus ſlowly, to get into the *veſiculous* Membranes, which are the *repoſitories* of Fact. But on the contrary, by watching we grow lean, becauſe while we watch the Blood is in a greater *Fermentative* Motion, by which the *Sulphur* of the Blood is diffracted, and diſſipated (as alſo in the muſcular Motion) which being diſſipated, the Blood becomes thin and *Acia*, which we call its *depauperate State*, in which it is fitted for eroding the parts, and hence ſome People are lean. Stretchings and Yawnings are certain ſigns of Drowſineſs, becauſe the relax'd parts hinder the free courſe of the Blood; ſo that theſe Contractions of the Muſcles are to expel the ſtagnatied Blood out of the Interſticis, where it places it ſelf; for the parts thro' which it is to paſs being relax'd, out of a want of Spirits to keep them *turgid* and ſubſiding, much impedes the motion of the circulating Blood.

The Cauſes therefore of Sleep are, that the ſpirits may be recruited, and we again render'd fit for ſuch *Functions* as are neceſſary for Life; ſo that the *Animal Spirits*, as they are the Cauſe of all our *Senſe* and *Motion*, are likewiſe the Subject of Sleep; and as when in their ſteddy careers they make us fit for acting, and doing ſuch things as the Soul determines; ſo when they are exhauſted, and unfit for Motion by this paucity, or alter'd ſtate, they are the Cauſes of Sleep, *i. e.* when they are no longer able to preſerve that Tye between the *Animal Faculties* which is neceſſary for producing of *Senſation* and *Motion*; and can no longer by their Reflux to the Brain excite any Perception in the Soul, of what paſſes, or is tranſacted in the Body; nor yet at the *ſouls* command, produce any Motion or Alteration in the parts of the Body, then we may be properly ſaid to ſleep, *i.e.* to leave off thinking and acting; the proper *Functions* of waking Perſons.

This being premis'd concerning the Nature of *ſleep*, let us now conſider the manner after which *Laudanum*, and other *Narcotic's* act on us, ſo as to make us ſleep firmly; which can't proceed from any *diſſipation* of the Spirits which it can cauſe, ſince we find it does not drive the ſpirits with any unuſual *celerity* into the parts, nor excite any more violent *Motions* then ordinary; ſo that it only remains that they hinder the *tranſcolation* of the Spirits by the *cortical Glands* of the

Brain, and thus produce a defect of them, which may be effected by two ways; either by irritating the Spirits circulating with the Maſs of Blood, and *incraſſating* the whole Maſs; or elſe, by obſtructing the pores of the *Glands*; but we can't ſuppoſe it acts after the former way, *viz.* by incraſſating the Blood, and intricating it's moſt *fermentative* Parts, ſince we find the Pulſe beat more lively after taking a *narcotic* Medicine then before; therefore it remains, that they act by obturating the Pores of the *cortical* Glands in the Brain; which Effect may well be attributed to *Laudanum*, ſince it is endew'd with *volatile alkaline* Salts, and a thick, intricating and *glutinous Sulphur*; for theſe Salts with their *Sulphur* being driven againſt the Pores of the Glands with the other part of the Blood, as to paſs by them after the mannner of Spirits, may be quickly conceiv'd to obſtruct them for a time, 'till by the Spirits continually this way circulating, together with the Blood by the *carotidal* Arteries, to the *carotidal* Veins, which conſtantly ſtrike againſt them, theſe Salts are at length freed from the Bondage of the *viſcid Sulphurs*, by which they were kept as Priſoners; which being perform'd, theſe *Sulphurs* circulate with the Blood, and the *volatile alkaline Fermenting* with the *Acids* of the Blood, and broke into extreme ſmall parts, paſs into the *Emporeum* of the *Brain*; by which time the Cauſe hindring the Spirits *ſecretion* being taken away, they are again, as before, ſecern'd, and ſo we awake. They who are much accuſtomed to the uſe of *Narcotics* don't ſleep with 'em, unleſs they take large Doſes; becauſe by their more frequent uſe the *carotidal* Arteries are dilated, and give a freer paſſage to the Parts circulating that way. We are more *hot* when we ſleep, becauſe the *Animal Spirits* not being admitted into the *Brain* that part out of which they are made, (*i. e.* the moſt *volatile* and *fermentative* of the Blood) remains in, and circulates with the Blood, thus encreaſing its *Fermentation*; for a *ſanguinis motu & calore omnis totius Corporis calor provenit.* 3. We are more apt to take *cold* when aſleep, than waking; becauſe the Parts are more relax'd, by reaſon of the want of Spirits which kept them *turgid*; for when the Parts are *relax*, the Pores are more open (the Body being now alſo very *hot*) that the *Nitre* of the *Air* more eaſily inſinuates itſelf and coagulates the *Lymph* thus hindring its Circulation along the *lymphatic* Veſſels, which are therefore with a continual *advent* of *Lymph* diſtended, and preſs the neighbouring *Fibres*, from whence that *diſtenſive* Pain in *Colds* obſervable proceeds.

A Præternatural Sleep is diverſly produc'd, according to its divers Degrees: 1ſt, An *Apoplexy* is a *Species* of *Sleep*, in which the Patient is depriv'd both of *Sleem* and *Motion*, ſo as that his *Pulſe*, *Reſpiration*, and *Deglutition*, remains; and this is caus'd by a too great *ſeroſity* of the Spirits in the *Brain*, which makes them dull and unfit for Motion; or elſe from their Defect; as after any violent Concuſſion of the *Head* and Commotion in the *Brain*;

or *Extravaſation* of Blood, which cauſes an Obſtruction in the *Glands*, *&c.* In fine, the greater is the *aqueouſneſs* of the Spirits (which happens in Conſtitutions abounding with *fixt Acids*; for theſe fixing the *Sulphurs* of the Blood preſs the *Serum* from the *ſulphureous Nexes*) or the more abſolute is their Defect (which is ſometimes perceiv'd in an extreme *viſcid* ſtate of Blood, that ſo obſtructs the Pores of the *cortical Glands*, as altogether to hinder *ſecretion*) the more univerſal will the Privation of the *Animal Functions* be; and on the contrary. A *Coma*, and *Carus ſomnolentum*, depend on the ſame Cauſe, and only differ in Degree. A *Lethargy* is alſo a Præternatural Sleep. in which the Senſe and Motion are diminiſh'd with a *delirium oblivion, and ſlow feavour*; And this is caus'd by an *Inflammation* of the *Tunicles* or *Meninges* of the Brain.

To *Sleep* ſucceeds our *Waking*, i. e. then, when that Defect which was the Cauſe of ſleep, is remov'd, we *wake*; ſo that when the thicker parts of Blood, by their long Circulations are diffracted, and brought into minute Parts by their *Fermentation*, and are fit to ſupply the part of Spirits, they paſs in their Circulation to the Brain, and are there ſeparated by the *Glands* in that part Seated; and from thence to the other parts of the Body, ſerving for its Motion and Senſe.

Some one may ask, how 'tis that we wake ſooner than ordinary, or whenſoever we are called, or mov'd, *&c.* 1. That this proceeds from the violent Motions, theſe give the Spirits

(for there are always ſome Spirits contain'd in the *Nerves,*) which, being too violently mov'd, are driven to the Brain, and there move the Fibres, cauſing a *perception*, as at other times in the Soul, tho' more confus'd.

Now therefore we are *Awake*, and able to conſult the *preſervation* of our Bodies, *&c.* and we ſo long remain ſo, as the Blood is able to ſupply a due *quantity* of *Animal Spirits*; and for this reaſon 'tis ſome can't Sleep, becauſe their Spirits are always in a *rapid* Motion, as in *Feavours*, *&c.* where the Blood by its continual and violent Motions, is always capable of affording ſome ſmall penetrating Parts, in which, alſo the *Sulphurs* are ſo diffracted, as to enter the *Emporeum* of the Brain, and there cauſe *inordinary Diſturbances*.

They who are wont to ſleep after eating, are moſt obnoxious to a *Phthiſis*, or Conſumption; becauſe the *Chyle* made out of their *Aliments*, by reaſon of the want of Motion, can't be intimately mingled with the Blood, nor ſo much diffracted as it ought to be; ſo that it remains more fit for cauſing *Obſtructions* in the parts 'tis carry'd thro' then *Nouriſhing* of them.

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